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THE INTERNATIONAL ABSTRACTS OF SURGERY

MICHAEL L. MASON, M. D., F. A. C. S., Chicago, Illinois

The INTERNATIONAL ABSTRACTS OF SURGERY, some 9 years younger than Surgery, Gynecology & Obstetrics, is approximately the same age as the American College of Surgeons. Both are brain children of Franklin H. Martin, as were SURGERY, GYNECOLOGY & OBSTETRICS and the Clinical Congress of Surgeons of North America. Each venture followed the other in natural sequence, and all were directed toward the same end—the education of the surgeon.

The Abstract Section of the Journal was developed to make authoritative résumés of the world literature in surgery available to American and British Surgeons. Surgery was considered in its broad sense since it was recognized that the basic sciences of anatomy, pathology, physiology, and chemistry are the foundation upon which surgery is built. Today, the young surgeon is almost as much at home in the physiologic and chemical laboratory as he is in the operating room.

In the beginning extensive negotiations were carried out with foreign journals and publishers to arrange for the interchange of material. For many years there was a regular exchange of galley proofs between this Journal and the "Zentralorgan fuer die gesamte Chirurgie und ihrer Grenzgebiete," as well as the companion German abstract journals on obstetrics and gynecology, and eye, ear, nose, and throat. A similar arrangement also obtained between the INTERNATIONAL ABSTRACTS OF SURGERY and the Journal de Chirurgie of Paris. Following the second World War, this amicable and mutually advantageous exchange was not resumed, and abstracting of material from all foreign journals is at present done by our own group of abstractors from the original material.

The preparation of abstracts is by no means the simple task which it might seem to be at first. Since it is not possible to abstract all of the literature in surgery as well as in the ever increasingly pertinent allied sciences, the first step consists in a careful selection of the subscription and exchange list. The choice of material from these journals is a difficult task and often presents embarrassing and seemingly unfair selections. Each article must be appraised from various viewpoints. Its source and authorship are of great importance. These established as well as possible, the article itself must be appraised as to new ideas and adequate presentation. Then, choice must often be made between many articles on the same topic and, if the topic is new and important, several of the most representative must be chosen. Finally, a balanced selection must be made from month to month so that each category of material is represented fairly and in proportion to the interest evidenced in the literature at the time. It is interesting to note from year to year the gradual shifting of interest in, and importance of, the various fields of surgery as newer areas are opened up by surgical research.

The preparation of the abstract is a task of love, since the abstractor must carefully avoid the injection of his own ideas into it. He must present, as briefly as is compatible with the substance, a condensation of what the article contains (not a glorified index of the article), stressing, of course, those things which the author stresses. This is not a predigested diet, but a concentrated one.

The securing of abstractors for foreign language journals would seem to be easy, but, according to experience, it is difficult and has become increasingly so. Whereas 25 years ago many surgeons had excellent reading acquaintance with one or more languages besides English, today a bilingual surgeon is a rarity and a trilingual one is found only in the older age group. This difficulty of securing abstractors for foreign material has been increased since the War, partly because of the greater amount

of foreign literature which we abstract and partly because of specialization. Earlier in the history of the Journal much of the German and French was received in abstract form and required only translation. Now, not only is all French and German material abstracted from the original, but all other foreign languages likewise. Added to this is the great increase in the amount of literature which is received. The other factor which has increased the problem of foreign abstracts is the increased specialization among surgeons. In 1914 the Section on General Surgery covered everything except obstetrics and gynecology, orthopedic and genitourinary surgery, and eye, ear, nose, and throat, and x-ray specialties. Orthopedics, it is true, was then a specialty, but much that is now included in orthopedics was included in general surgery 40 years ago. Today the field of general surgery has been split into many special fields and each specialty must have its own abstractors.

To the scores of surgeons who have worked hard in the preparation of the abstracts not only we but more particularly our readers must be extremely grateful. Many men have been on the abstract staff for years, and have faithfully carried on with what must at times have been onerous tasks to meet publication deadlines.

The actual processing and editing each month of several hundred abstracts and the correspondence necessary to send out and get back the manuscripts require careful organization of work. It would be appropriate here to mention three individuals who, through long association with the Abstract Section, have contributed greatly to its success—Miss Leonora Perry, who was for many years in charge of the technical direction of the abstracts, to be followed in 1936 by Miss Charlotte Fritsch and Miss Adeline Thiem who have served in the Abstract Section for more than 27 years. It is their labors which have made possible the publication of the INTERNATIONAL ABSTRACTS OF SURGERY in correct form and good English—and on time.

The Collective Reviews were started at the time the Journal was founded as monthly Collective Reviews. These articles fall roughly into two main classes: the "present status" class and the "review of the literature" class. The line of distinction is not great in some instances since many of the "present status" type are critical reviews of the literature and an appraisal of the present views on treatment or opinions as to the etiology or nature of a condition. The Collective "review of the literature" may, likewise, deal with critical discussion of the literature having to do with some clinical entity or surgical field. There is obviously place for each type of review since the surgeon should halt from time to time and survey the field to see just where he is getting and to review again efforts in the recent or less recent past to solve the problems with which he is confronted today. These reviews are of necessity long and difficult to prepare; they demand the reading of a vast amount of literature and thoughtful consideration of it. Each publication must be appraised and arranged in proper relation to the others in point of time and importance. This is the labor which many men put into the preparation for publication of some particular piece of investigative work, or in "reading into their specialty." A great deal of useful information is gathered and condensed, and, with the extensive bibliography, is very valuable not to the individual alone but to other surgeons.

The series of Collective Reviews for 1955 has been especially designed to cover in a historical fashion the development of surgery during the past 50 years, i.e., since the founding of SURGERY, GYNECOLOGY & OBSTETRICS. Fifty years ago it would not have been as difficult to select topics for 12 separate reviews as it is today. A review of general surgery would have encompassed many of the present specialties, and 11 more titles would have well covered the field. For the selection of the present set of 12 topics, long lists of titles were prepared and discussed, and the choice proved to be extremely difficult. It is realized that at least double the number of reviews would be required to give even a fair concept of the growth of surgery and its allied sciences in the past 50 years

The review by Frank Meleney on the progress in the management of surgical infection during the past 50 years covers the period when antiseptic surgery was replaced by aseptic surgery. During this time, the search for substances to be placed in wounds to kill bacteria was gradually decreased because of the concept that keeping bacteria out of wounds and removing from them substances favorable to bacterial growth were more important than attempts at local destruction. On the other hand, the latter half of this same period has seen the discovery and development of the most potent antibacterial agents known to man. It is quite fitting that Meleney should contribute this particular review.

The entire field of nutrition of the surgical patient, and the rational concepts of fluid administration and of causation and therapy of shock are strictly developments of the past 50 years. From studies, both clinical and experimental, on the fluid, electrolyte, and food requirements has come our whole present day concept of preoperative and postoperative care and of the prevention and treatment of shock. The vast clinical material furnished by the last World War and the Korean conflict was wisely studied by many research teams. The laboratories and clinics of all the universities of the world have made thousands of contributions on various facets of this problem. A review of these developments will be made by Ravdin who has been in the thick of this conflict.

Cancer is conceded by most surgeons to be the number one unsolved problem in surgery. Surgical eradication of cancer, i.e., its complete removal, is dependent upon knowledge of its routes of extension, upon increased diagnostic facilities for early recognition, upon adequate anesthesia, upon suitable preoperative and postoperative care, and upon suitable operative technique. The study of the effect of the endocrines and hormones upon cancer growth is purely a product of the past 50 years. A review of these various advances in cancer surgery will be given by George Pack.

Surgery of today is physiologic and biochemical. Probably none of the basic sciences has contributed so much to modern surgery as has physiology. A review of only the high spots in physiologic contributions to surgery will result in a striking and significant array of material. This will be the subject of the review by Lester Dragstedt.

Intrathoracic surgery has progressed rapidly from the beginning of the century when drainage of empyema was almost the only surgery attempted. Today, empyema is uncommon and the thoracic surgeon carries out procedures on the lungs, heart, and great vessels which were almost undreamed of 50 years ago. The rapid advances being made in this field of surgery are evidenced by the great amount of space allotted to it in all surgical journals, and by the various special journals devoted to surgery of the chest.The esophagus has shared with the lungs and heart the acquisition of accessibility, and great steps have been made in the surgical management of conditions of this portion of the gastrointestinal tract. The growth of this specialty will be reviewed by Brian Blades.

Neurosurgery shares with thoracic surgery in being particularly a child of the past 50 years. As with thoracic surgery, its solution depended first upon the conquering of certain very definite technical problems before operations could be successfully carried to completion. While the roots of this specialty go back to prehistoric antiquity, its logical and scientific development has occurred within the memory of the senior neurosurgeons of today. John Scarff will present the growth of neurosurgery in the past 50 years.

The roots of gynecology do not go back into the past as do those of neurosurgery, but its establishment initially as a surgical specialty, or rather as a large special field of general surgery, was much earlier than that of neurosurgery. The main operative procedures in gynecology had been established before SURGERY, GYNECOLOGY & OBSTETRICS and, although many advances in technique have come in the 50 years since 1905, the female pelvis was opened with assurance long before. Advances in

gynecology have come along numerous lines: the better understanding of cervical carcinoma and methods of dealing with it, a better understanding of other tumors of the female genital system, a logical concept, and the better understanding of intricate endocrine interrelationship of the female sex organs. This complex field will be reviewed by Joe Vincent Meigs.

Urology, likewise one of the older established specialties of surgery, has made some enormous advances in the past 50 years. The development in operative and manipulative technique has been extensive. Operations upon the kidneys and ureters, and upon the bladder and prostate have become established on a basis of universally recognized principles. The factors leading to renal stone formation are better known, and the relationship of the kidneys and adrenal glands to hypertension is being elucidated. The complex physiology of the kidneys and its significance to the general body physiology, and to shock and shocklike states are being studied intensively. It has even been possible to construct an artificial kidney which functions for a day or more in a very efficient manner. This field of surgery and the advances made from 1905 to 1955 will be reviewed by Charles Higgins.

The successful accomplishment of much of modern surgery depends upon skilled anesthesia. This implies so much more than just putting the patient to sleep or rendering him oblivious to pain and discomfort that the anesthetist of today has become a highly skilled expert in physiology. He is becoming a partner in the surgical operation and not merely a skilled assistant. The growth of anesthesia and the emergence of anesthesiology as a specialty in surgery during the past 50 years will be discussed by Henry Beecher.

Plastic surgery has not only grown into adulthood since the early part of this century but has made a real impact on all surgery. The past war has seen the triumph of plastic surgery and the growth of a whole group of plastic surgeons, serious-minded and earnest in the development of this important field. The plastic surgeon, with his meticulous technique, his respect for tissues, his insistence on careful hemostasis and respect for blood supply, his demand for fine instruments and suture material, and for accurate closures has called the attention of surgeons to the importance of these principles in all surgery. Plastic surgery is no longer synonymous with skin-grafting; the plastic surgeon has put skin-grafting where it belongs, as a technique of surgery applicable to all fields of surgery, just as is suturing or hemostasis. Barrett Brown will review the advances in plastic surgery.

Radiology, included in the first issues of the INTERNATIONAL ABSTRACTS OF SURGERY with electricity, has come far since the early days of 1905 when the whole field of x-ray diagnosis and therapy was just being opened up and radium therapy was yet to be explored. The eventual application of these and of other radioactive forces, was practically unsuspected. Within the past 10 years has come the development of atomic energy and its adoption to surgical diagnosis and therapy. This broad field presenting many facets for development will be covered in the review by Paul Swenson.

The final review of the series will deal with surgery of the hand, and it seems peculiarly fitting, to the editors, that this subject should be included in the series. While hand surgery demands techniques developed in various of the other branches or specialties of surgery, its successful pursuit must rest in a single individual. The reconstruction of an injured hand can best be accomplished by a single surgeon with mastery of the various special techniques. More particularly, however, hand surgery is considered in this series because of the influence of a former editor of the Journal, Allen B. Kanavel, in the development and growth of surgery of the hand.

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THE PAST 50 YEARS IN THE MANAGEMENT OF SURGICAL INFECTIONS

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I CONSIDER it a great honor to be invited to take part in the Fiftieth Anniversary of the publication SURGERY, GYNECOLOGY AND OBSTETRICS and to be asked to review the progress which has taken place in the control of surgical infections during the last half century.

It would seem safe to state that there has been greater progress in this field during the last 50 years than in all of the preceding recorded history. Although there are accurate descriptions of the incidence and course of surgical infections in the ancient medical literature, very little was known about their management and control until very recent times.

Progress really began to be accomplished only after it was demonstrated by Pasteur that suppuration and putrefaction in wounds were due to the action of micro-organisms. Then for the first time an effort was made by Lister to prevent the entrance of organisms into operative wounds. It took almost a quarter of a century for Lister's theories to be accepted by surgeons throughout the world. Indeed his ideas were accepted more readily in foreign countries than in his own England or in English-speaking America. In fact, it was not until the end of the nineteenth century that the general principles of operating room sterile technique gradually evolved. The scope of surgery then began to expand into fields which had previously been closed to the surgeon because of the certainty of the development of fatal postoperative infection.

In the preparation of this review, it was thought best to divide the period into decades and to show the progress of the management and control of surgical infections from one 10-year period to the next. Therefore, the articles which appeared in SURGERY, GYNECOLOGY AND OBSTETRICS during the first 2 years of each decade were carefully scrutinized and the most significant papers were abstracted as examples of the thinking and the experience of surgeons at the beginning of each 10-year period. Furthermore, during the later years of each decade other outstanding articles were abstracted, if they covered anything of importance which had not been mentioned in the first 2 years of the decade.

The articles referred to in each decade will not be presented in strictly chronological order, but will be grouped together according to the subject considered. Particular emphasis will be placed on the first and fifth decades, in order to show the contrast between these two periods of time.

THE FIRST DECADE OF THE PUBLICATION OF "SURGERY, GYNECOLOGY AND OBSTETRICS" (1905–1914)

It is of considerable interest that the leading article in the first issue of SURGERY, GYNECOLOGY AND OBSTETRICS was written by the great Nicholas Senn (1). His subject was "Iodine in Surgery, with Special Reference to Its Use as an Antiseptic." He mentioned that Liebig first showed the antiseptic properties of iodine and thought that it was due to the fact that it combined readily with albuminous substances and coagulated them. Senn stated that Roux, of Lausanne, first made use of the tincture of iodine in completing hand disinfection. He dipped his finger tips into the tincture for the purpose of reaching and destroying microbes lodged in subungual spaces and folds of the fingernails. Senn quoted the opinion of Samuel Gross, the "Nestor of American surgery," who said that "its reputation in erysipelas is fully established. . . . It is also of great service in boils, carbuncles, whitlow, corns, bunions, and inflamed irritable ulcers of the extremities." Senn confirmed the opinion of these other men and was particularly impressed with the medicative effect of iodine applied to the surface of the skin in cases of erysipelas and superficial lymphangitis, and testified as follows: "I have seen the most virulent forms of streptococcus angitis speedily arrested under the application of a compress saturated with an aqueous solution of iodine." In cases of suppurative synovitis of the knee joint, Senn advocated incision followed by free irrigation of the joint with a one per cent solution of iodine. He stated that suppuration was arrested at once, "a result . . . never obtained with any other antiseptic." He used the same treatment in large phlegmonous abscesses with equally satisfactory response.

The surgeons of the day were interested in the sterilization of the patient's skin, and the general consensus of opinion was that iodine had demonstrated its effectiveness better than anything else. There were advocates of the mercury compounds for the preparation of the skin, and various experiments were reported, advocating certain concentrations and combinations. Some of the workers in this field realized the importance of simulating conditions as they existed in the field of the operation, and particularly the inhibiting effects of blood, pus, and tissue fluids.

In 1911, Cannady (2) reviewed the history of iodine methods of skin sterilization and came to the conclusion that iodine was "at least one hundred times more powerful a bactericidal agent than bichlorid."

Tinker (3) was one of the advocates of very great care in the preparation of the skin of the patient and of the hands of the operating team. He stressed the time element in the effective use of iodine and also in the mechanical removal of the bacteria from the hands by the scrub brush. He believed that for the preparation of the hands the most important step was a 5 minute scrub-up with soap and water followed by the application of chlorinated lime and soda and then of bichloride solution and alcohol, or of Harrington's solution, which was a combination of "1 to 250 bichlorid of mercury with 2 per cent of hydrochloric acid in 95 per cent alcohol."

Willis MacDonald (4) was one of the first to place the responsibility for the development of infection in clean operative wounds on the doctors and nurses. He stressed the importance of a check-up of all of the procedures in the operating room and on the wards with bacteriological studies in a well appointed bacteriological laboratory. He pointed out that there is a fine spray of infective saliva expelled from the mouth during conversations and said: "One can readily imagine the conditions involved in a demonstration operation where the unmasked operator lectures as he operates to a crowded clinic and is surrounded by assistants and visitors. It is no wonder that disturbed wound-healing, with leucocytosis and so-called surgical fever, occurs occasionally." He stated that "visitors to operations, either the attending physician of the patients, or visiting physicians, or students, are a constant menace to surgical asepsis, even though their clothing is covered by sterile gowns. In their anxiety to see the details of the operation, they crowd upon the field of operations, ask questions, cough near the instrument table, and bring large quantities of macroscopic dirt on their shoes to the operating-room." He took cultures of the air in the operating room and demonstrated that the number of colonies on the plate was influenced by the number of spectators. He stressed the importance of keeping the staff bacteriologically minded by frequent cultural check-ups on the various steps of the sterilization processes and

the preparation of the skin of the patient and the hands of the operating team. However, he did not seem to appreciate the fact that the nose as well as the mouth of each member of the operating team was a frequent source of contamination. Incidentally, MacDonald stated that there was no method then known of being certain of the sterility of catgut, particularly the chromicized variety, and he considered that that might often be the source of contamination in operative wounds.

E. Stanmore Bishop (5) in 1908 was loath to admit that the value of the use of gloves and masks by the operating team outweighed the difficulties encountered. He decried especially the lengthening of the time of operation caused by these impedimenta. He stated: "There is something very attractive to most minds about special uniforms, special costumes and special surroundings; and there is a spectacular impressiveness in the figure of a surgeon entirely covered, except for his eyes, in aseptic clothing; he looks like a high priest of surgery, and priests have in all ages been regardful of the effect of vestments upon their followers." He thought it "conceivable that men trained from the first to work in rubber gloves may in the end and after much practice be able to use their fingers as deftly as if they were bare, but this entails much increased risk to the patients upon whom they practice." His objection to masks he considered very serious because of the "feeling of terror" which frequently assails the patients just before anesthetization, which "is intensified by surrounding the patients with faces and forms which are unfamiliar and unknown and which suggest the antechamber of torture in some Spanish Inquisition instead of the cheerful, hopeful, pleasant faces to which they have become accustomed and in whom they have learned to trust."

As late as 1911, there was a lively discussion of a paper by W. P. Carr (6) entitled "Saving the Hundredth Man." Carr reviewed the chief causes of death following surgical operations and found that sepsis easily led the list, with hemorrhage and shock as next in frequency. Although he believed in minimizing the entrance of organisms into the operative field, Carr objected to the use of gloves. "First," he said, "they interfere to some extent with our sense of touch. . . . It may seem a small matter, and in most operations perhaps it is, but in some cases I am sure this one thing is the determining factor of life or death for the patient. I believe firmly that more patients have died from the use of gloves than have ever been saved from infection by their use. . . . Secondly, the glove leads to longer incisions which take a longer time to sew up and in other ways consumes time that, in not a few cases, is of life-saving value." He stated that gloves, rather than protecting a patient from infection, added to the probability of such an event. He believed that hands could be sterilized, and reported as circumstantial evidence that he had "opened the knee joint over two hundred times without a single infection—with bare hands. There is no better practical test of asepsis, for there is no part of the body more easily infected than the knee joint."

Allen Kanavel (7) made his classical studies of the anatomy and the treatment of infections of the hand during the first year of publication of SURGERY, GYNECOLOGY AND OBSTETRICS. He undertook the study because experience had demonstrated that after the most laborious treatment, many cases of hand infection resulted in unfortunate sequelae and even in amputation. He demonstrated that: "There are certain well defined uniform spaces upon the fingers, palm and dorsum of the hand in which pus can accumulate. There are definite anatomical channels in which infection arising in a given spot will extend to certain of these spaces, while certain other spaces will remain uninvolved. Hence the diagnosis of the position of the pus is simplified and the proper site for the incision determined. There are definite anatomical channels by which pus can spread from the uniform spaces mentioned and when this occurs, the position of the pus can be prognosticated. The boundaries of the fascial spaces having been determined . . . the incisions for evacuation must be made at definite spots, otherwise important structures may be injured . . . and a spread of the infection favored to parts of the hand which would not otherwise have become involved." Kanavel placed infection in the hand in three categories: (1) lymphatic infection not accompanied by accumulation of pus, (2) infection of the synovial sheaths, and (3) infection in the spaces between the fascial layers. Sometimes there may be a combination of these three forms.

Kanavel stressed the importance of treating all wounds of the hand with aseptic care. In

cases in which it is difficult to decide whether or not a localized abscess is present, "immobilization and the local use of the well-known hot moist dressing is probably more efficient than any other application." He pointed out the exact site for the optimal drainage of each of these spaces.

Kanavel (8) continued his study of the hand by a careful determination of the anatomical variations in the tendon sheaths, and from his extensive experience he outlined the chief causes of tendon sheath infections and the course which they pursued, with and without proper treatment. This he did by careful injection of opaque material into the sheaths and a study of their limits by means of x-ray films. The connections between the tendon sheath of the thumb with the radial bursa, and the little finger with the ulnar bursa were clearly demonstrated, while those of the other three fingers were generally found to be independent. Kanavel pointed out the importance of draining these sheaths as soon as possible after it was demonstrated that they were infected, and showed how incisions could be made to do the greatest amount of good with the least possible harm.

The surgeons of the time were particularly interested in appendicitis. Although the first recorded case of appendicitis had appeared in the literature about 150 years before, and 80 years previously Mélier had demonstrated that the appendix was "an organ susceptible to disease arising primarily in its own structure," the diagnosis of acute appendicitis was rarely made and treatment rarely administered before the organ had perforated and had produced either a localized abscess or a diffuse peritonitis.

Kennedy (9) was one of the early advocates of early removal of the inflamed organ. He stated that "medicine, remedial agents or time should never be looked upon as factors in the treatment." He pointed out the means of making early diagnosis and the necessity therefor. Following his master, Joseph Price, Kennedy advocated very radical treatment of appendical abscesses, recommending removal not only of the appendix but of all fibrinous exudate and not considering the walling off of the abscess of any particularly protective value. Even in very late cases with general peritonitis, distended abdomen, and intestinal obstruction, he and his chief advocated "the most complete toilet that it is possible to make. . . . Every inch of the bowel that is possible to eviscerate is delivered through the incision, all adhesions released, both sides of mesentery exposed and cleansed, all viscera flushed and wiped off with gauze while external. The abdominal cavity is then flushed out with several gallons of water" followed by coffer-dam drainage. Kennedy then added these significant words: "I realize I have made a plea for radical and heroic treatment of this disease, but such has been my apprenticeship under an operator who has the courage of his convictions and a mortality of less than one per cent."

Charles Peck (10) voiced the opinion of many more conservative surgeons in the following summary: "Immediate operation is preferable to delay in all cases of severe appendicitis of whatever type. Small incisions simplify technique, and favor the least amount of trauma, shock, and expenditure of time in the operation. They also lessen the danger of post-operative hernia, and of extensive post-operative intestinal adhesions. The use of gauze pads for walling off the operative area should be limited, as a rule, to cases with well-localized abscesses. Abundant saline irrigation is the most rapid and satisfactory method of removing infective material in cases of spreading peritonitis. Attempts to drain the general peritoneal cavity are useless; drainage should be limited to abscess cavities, and to the region of the stump in cases in which a clean inversion with complete removal of necrotic material is not obtainable. After-treatment should be simple, with little or no attempt to irrigate or cleanse drainage tracts, even in cases where the discharge is abundant."

In 1905 John Yates (11) made an experimental study of the local effects of peritoneal drainage and concluded that "the drainage of the general peritoneal cavity is physically and physiologically impossible." He found that the encapsulation of the drain developed promptly, because of the formation of fibrinous adhesions which became organized within a few days into real fibrous tissue. He believed that if the irritation persisted, adhesions became progressively more dense, and stated that "after irritation ceases, their disappearance depends principally upon a mechanical factor,—the ability of the involved surfaces to pull themselves or to be "pulled loose." He believed that drains should be the least irritating and should be gradually and finally removed as soon as possible. After the removal of the drain he advocated stimula-

tion of intra-abdominal activity to aid in the disappearance of the remaining adhesions.

John Dill Robertson (12) attempted to study the etiology of appendicitis and stated that "bacterial invasion of the appendix, especially by the colon bacillus . . . is now known to be the only cause of the disease." He was led to "a positive conclusion as to the exact etiology of the disease, which may be expressed as follows: Inflammation of the appendix vermiformis, like all inflammations, is associated with vascular disturbances which not only accompany but precede the inflammation."

Charles Stanley White (13) stressed a point in technique designed to minimize the possibility of hemorrhage after appendectomy. He thought that the hemorrhage was due to erosion of the deep epigastric artery by the drainage tube or to its opening by advancing infection, and he advocated therefore the ligation of this artery and its veins in the lower end of the incision "using two ligatures about an inch apart."

John B. Murphy (14) in 1908 pointed out the fallacy of a "chemical" peritonitis in cases in which cultures from the peritoneal fluid showed no growth. He believed that this fluid was protective and might be sterile, while fluid nearer the source of infection might reveal the causative organism. He recommended postoperative proctoclysis by the continuous method. He also advocated antistreptococcic serum "in those cases where local resistance is meagre and the leukocytic reaction feeble. . . . 20 c.c. are injected immediately after operation and the same quantity each succeeding twenty-four hours until the patient is out of danger."

Russell Fowler (15) was particularly interested in the treatment of acute diffuse septic peritonitis and reported that of 167 patients upon whom he operated personally at varying intervals following perforation, only 17 were treated within 24 hours of the onset. As a result of this experience, Fowler came to the following conclusions with regard to treatment: (1) early operation, (2) incision small enough to avoid eventration, but large enough to deal with the primary focus of infection, (3) intestines treated as gently as possible, kept back with "laparotomy sponges wrung out of bichloride of mercury," (4) inversion of the appendical stump preferred, (5) ligation of appendix only when inversion is impossible, (6) drainage only if pus is thick and profuse, (7) drainage of necrotic areas with wicks, (8) elevated head and trunk posture to lessen the rapidity of absorption of septic products (This came to be known as the "Fowler position."), (9) saline solution by rectum postoperatively, and (10) fluids by mouth "unless for some reason it is desirable to quickly dispose of the peritoneal fluid."

George S. Brown (16) confirmed by his own experience the value of the Murphy proctoclysis and the Fowler position. He believed, however, that the chief value of this treatment was not due to the administration of fluid or to the position, but to keeping both the stomach and the bowel empty and quiet so that nature could produce adhesions which held the inflammation in check. "Up to the advent of the Murphy-Fowler treatment it had been the practice with practically all surgeons in this country, to follow all operations for appendicitis with purgatives." Brown believed that Ochsner should be given the most credit because of his plan to withhold purgatives and thus keep the bowel quiet. He said: "All will agree, the Fowler position is useless unless a drain is used. If a drain *is* used there are two objections to it. First, if the patient's condition is bad he will not often bear elevating to the forty-six degrees said to be necessary to drain the iliac fossa into the pelvic cavity. . . . The other objection is that it must be purely theoretical that the serosa of the pelvic cavity has a greater resistance to germs than that of the iliac fossa." Brown suggested that a series of cases be treated in two ways: one, by using the proctoclysis and the Fowler position with purgatives, and the other, by foregoing the Murphy-Fowler features but thoroughly emptying the stomach, withholding all food and purgatives, and keeping the patient quiet by giving opium.

The surgeons of that first decade were greatly interested in the occurrence of appendicitis during pregnancy, and there was a very great difference of opinion as to what should be done under those circumstances. J. Clarence Webster (17) believed that "every non-pregnant woman who is likely to become pregnant, in whom a definite attack of appendicitis has once occurred, should have her appendix removed before pregnancy is allowed to take place. . . . When the condition is diagnosed for the first time during gestation or when there is a recurrence of an old attack, it is advisable to operate as soon as possible. . . . When an attack of appendicitis occurs during

labor, operative interference should be carried out very soon after delivery."

It was Henry Coe's opinion (18) that "the majority of cases of appendicitis in pregnant women belong to the mild recurrent class and can often be tided over until after labor." He advocated, however, "in the presence of perforation and abscess formation, operate without delay, disturbing the uterus as little as possible and draining freely."

Thomas Watkins (19), writing on the pelvic infections in woman, stated that "nearly all pelvic infections occur through the vaginal canal, a very few of them reach the pelvis through the general circulation and a very limited number are the result of migration of bacteria through the intestinal walls. . . . The gonococcus is a more common cause of pelvic infection especially in the non-puerperal state than any of the microorganisms and produces more suffering than all of the other bacteria. . . . Puerperal infection continues to be a rather frequent disease in women confined outside of public institutions." Watkins observed: "It would be well were it possible to require every physician to use an instrument sterilizer in his office so as to diminish the danger of carrying infection from one patient to another."

Sir William Sinclair (20) of the University of Manchester in England, was of the opinion that puerperal fever should be treated surgically. He wrote: "There is only one etiology of puerperal fever, the poisoning of a wound, and there is essentially only one method of treatment, to make the wound clean. The most effective way to make a wound clean is to use the curette, with the addition of certain supplementary proceedings which are essential to success. . . .

"We shall assume that the diagnosis is complete, 'puerperal fever' in the early stage—sapremia or septicemia, it matters not which—the uterus must be cleared out, the infecting material must be removed, and the toxine distillery razed to the foundations. The wound in the uterus must be made as clean as if it were external, and under inspection. If the perineum has been torn badly and sutured, and if the sutures have not held, and the opposing surfaces which refuse to unite are covered by a pseudo-diphtheritic membrane, it is not enough to let a trickle of saline solution pass over them; they must be thoroughly swabbed and rubbed with a germicide solution which is above suspicion. I prefer carbolic acid or corrosive sublimate; some use iodine; others, izal or some other chemical. Just the same process must be applied to similar wounds in the vagina and in the cervix. The wound or absorbing surface within the uterus only differs from these because of its anatomical relations, which make it more dangerous, therefore it should receive our chief attention and if possible be more thoroughly cleaned. The difficulty of getting at it, the technical difficulty, does not affect the principles involved. . . .

"While in a very small number of the most serious, complicated cases, the best treatment may still be vaginal hysterectomy, the general opinion of obstetric surgeons is steadily growing in favor of other operations. These are (1) ligation of thrombosed pelvic veins with or without clearing out the contained thrombus, and (2) abdominal section and drainage in the treatment of acute puerperal peritonitis. . . .

"In the lymphatic form of puerperal fever, operative measures may still be resorted to in cases hitherto considered desperate, when douching, curetting, swabbing, tamponade, and all the other inner methods of treatment have failed. The record of successful operations during the last few years is highly encouraging. We need no longer stand by helpless, or engage actively in superintending a process of euthanasia. . . . All who write upon the subject are agreed that the chances of success diminish according to the delay in operating after the onset of peritonitis."

Rudolph Matas (21) was very much interested at that time in the problem of postoperative tetanus, an unexpected complication of operations on the intestinal and genital tracts. He stated that "abundant experience has shown that while the risk of tetanus infection can be absolutely eliminated in all operations upon sterile tissues in which a rigorous asepsis can be maintained until healing has occurred, this liability cannot be removed in those regions in which postoperative asepsis cannot be secured . . . those regions of the body which are most exposed to faecal contamination." Matas pointed out that the alimentary tract of man is copiously contaminated with tetanus organisms because of the habit of eating "raw, uncooked vegetables, berries, and other fruits which are cultivated in fertilized or manured, i.e., tetanized, soil." He demonstrated that in 5 per cent of normal men, the organism could be found in the intestinal

canal and that this percentage was increased to 20 in hostlers, stablemen, and dairymen. He stated that "precautionary measures would be more than justified if only one in ten thousand operative cases could be saved from the almost certain death which follows when this form of inoculation occurs after operation" and he outlined the following simple treatment: "(a) purgation three days before operation; (b) the suppression of all raw, uncooked food, especially green vegetables, berries, and other fruits for the same period of time before the operation. In emergencies . . . tetanus antitoxin . . . injected subcutaneously at the time of operation."

Joseph Blake (22) suggested for the treatment of tetanus the injection of magnesium sulfate by lumbar puncture "inhibiting both afferent and efferent nerve impulses."

George Emerson Brewer (23) in 1906 gave a comprehensive review of the suppurative processes in the kidneys accompanying severe blood stream infections with streptococci and staphylococci. He demonstrated experimentally that if bacteria were injected into the blood stream, no lesions developed in the kidney unless previous to that time the kidney had been injured by some form of trauma. He came to the conclusion, therefore, that the unilateral involvement of the kidney in septicemia so frequently seen, was the result of some previous injury.

A great deal of attention during this first decade was given to the problem of acute and chronic osteomyelitis. It was apparently one of the major problems of surgery at that time. Thomas Huntington (24) stressed the value of early radical treatment in cases of acute osteomyelitis of the femoral head and neck, which he said was the primary lesion in about 95 per cent of all hip joint infections. He recommended an approach through the great trochanter without entering the hip joint itself.

Frederick Dyas (25) pointed out that in cases of acute hematogenous osteomyelitis the organism gets into the blood stream from some suppurative focus like a furuncle, but in many cases the portal of entry cannot be determined. In his experience, infections with the Staphylococcus aureus occurred in cases of moderate severity, while he said, "The streptococcus produces a rapid necrosis of the bone and is frequently fatal." He stated his belief that treatment is always surgical and "consists of relief of the tension and evacuation of the infected material as soon as the diagnosis is made." He believed that the medullary cavity should be opened and if necrotic tissue was found, "the bone should be thoroughly chiseled away." He also advocated thoroughly disinfecting the cavity with solutions of carbolic acid, bichloride of mercury, or formalin. He then carried out the procedure advocated by Murphy by filling the cavity in the bone with a liquefied mass containing glycerin, gelatin, water, and formalin, which solidified at body temperature. Next, he sutured the skin flaps over this mass, and stated that "the results obtained by this method of treating the osteomyelitic cavity have been most satisfactory." However, his next sentence cast some doubt on this, when he wrote, "The further treatment consists in frequent dressing, removal of sequestra and spiculae of bone, orthopedic measures to correct and prevent deformity, and constitutional treatment, consisting of extract of thyroid and tonics."

Charles Scudder (26) stressed the importance of using the reparative power of the periosteum in the treatment of certain cases of acute osteomyelitis of the long bones. He advocated in many cases the early removal of necrotic bone, but stated that the periosteum should be preserved when the necrotic bone was removed to hasten regeneration of the shaft. He stressed the importance of splinting and traction in order to prevent deformity of the newly formed bone.

Carl Beck (27) wrote a series of papers during this first decade, giving his experiences with chronic osteomyelitis. Recognizing that the disease was usually caused either by the streptococcus or by the staphylococcus, he pointed out that the inflammation causes a "melting process of the tissues" and "the formation of an abscess." Beck was particularly pleased with the advent of the roentgen ray films, which then for the first time gave a clear picture of the extent of bone involvement. He said, "Unfortunately, not a proper use is made as yet of this method, and many surgeons and radiologists are still of the opinion that the diagnosis of an abscess or sequestrum in the bone by the rays is impossible." However, he believed that such a diagnosis could be made with great accuracy. He added a new procedure, namely, the injection of a bismuth paste, "which penetrates the fistulae and often outlines the cavities with great clearness." However, he warned, "If not properly

done, this injection will mislead rather than help. . . . The proper way of diagnosing a case of suppurative osteomyelitis is to take several pictures in a certain rotation and study them carefully. It is the greatest mistake made as yet that very few surgeons diagnose their own radiographs, but rather leave it to a special radiologist." Beck used the anterior, rather than a lateral, approach for osteomyelitis of the femur.

The main object of Beck's first paper was "to show the necessity of correct diagnosis by systematic X-ray examination, and the absolute necessity of radical operation if we want to obtain results. Diagnosis without radical operation . . . will never result in a cure. Radical operation, on the other hand, . . . without a correct diagnosis, will do more harm than good. . . . Correct diagnosis and radical operation must go together."

In a subsequent report, Beck (28) stated that in the surgical treatment of chronic osteomyelitis, particularly of the long bones, three principles should be observed: "1. Remove all diseased bone. In order to be able to do that, one must make a very extensive incision if necessary. 2. Save the periosteum as much as possible. Sacrifice as much as necessary of the bone . . . depending upon the periosteum for formation of new bone. 3. Avoid the formation of irregular cavities which do not allow a mechanical closure of the wound." He stressed again the importance of repeated x-ray films, particularly stereoscopic views, in order to be sure that all of the dead bone had been removed and there was no further spread.

The surgeons of the first decade were interested in the use of vaccines for the treatment of infection, having been impressed by the work done by Sir Almoth Wright and his success in cutting down the incidence of typhoid fever among the soldiers of the Boer War by means of mass typhoid vaccination. McArthur and Hollister (29) carried on a series of investigations and came to the conclusion that "for the more common surgical infections, such as tuberculosis, staphylococcus, gonococcus, colon bacillus, streptococcus, etc., phagocytosis is the chief, if not the only, means by which such invasions are combated." They believed that their experience justified the following statement: "As to the value of vaccine therapy . . . : (a) It is of distinct value in the treatment of chronic localized tuberculosis of the bones, joints, glands, and urinary tract, acting not only as a general tonic, but as a local stimulant to repair of tissues; (b) It is of marked value in the treatment of staphylococcus affections, such as acne, furunculosis, etc. (we do not report a large number of such cases, but clinical improvement has been universal in all cases we have treated); (c) It seems to be of definite value in the treatment of urinary tract infections by the colon bacillus." They believed that vaccination increased the opsonic index and felt that they could demonstrate and follow the improvement during treatment by a rapid estimation of the number of phagocytes in the circulating blood.

Hartwell, Streeter and Green (30) reported 97 cases of general sepsis from the pathological laboratory of the Massachusetts General Hospital treated with bacterial vaccines. They stated: "In every case the pathogenic organism was determined by culture, and in the majority an 'autogenous' vaccine was used." They came to the conclusion that bacterial vaccines should be further employed in puerperal infections which do not immediately respond to routine treatment, and that bacterial vaccines are of much value in that type of sepsis which has remained stationary for some time, but not in other types.

It is indeed surprising that these favorable reports should have been made by surgeons in this first decade, because it is now well known that the human and animal body is incapable of producing any general immunity against the necrotizing and pyogenic organisms which produce surgical infections.

L. Wrede (31) of the University of Koenigsberg, criticized the treatment of acute suppurative infections by passive hyperemia and cupping, as advocated by Professor Bier. He wrote: "Bier holds that the infections of the body are overcome by inflammation and the good which he seeks is the augmentation and increase of the inflammation." Wrede contended, however, that "it cannot, according to my comprehension of inflammatory processes, be right to increase the inflammation beyond a certain limit, since it otherwise takes with it an undesirable concomitant, namely, injury to the body. . . . Lexer was the first to point out the danger of increased destruction of tissue through intensification of the inflammation by Bier's method. . . . The body is not always in condition to produce the increase of inflammation above that which it already has. . . . The modern physician is dependent

upon bacteriology. His need for causality in therapeutics is directed, not to the symptoms of inflammation, but to the cause of the disease." In order to combat bacteria and their toxins, Wrede advocated making an incision to bring the bacteria and their toxins to the surface and to eliminate them. "The ideal of surgical therapy is to know the cause, act accordingly, and not wait to see if the body will be so kind as to react to the strengthening measures of internal medicine." He believed that Bier "mistakes and underrates the value and importance of the incision in his treatment," regarding it as a side issue, whereas in Wrede's opinion, it was of primary importance in the treatment of any acute suppurative infection.

Thus endeth the first decade of the publication of SURGERY, GYNECOLOGY AND OBSTETRICS. In this period we have had a brief glimpse of what certain "all time greats" thought about problems of surgical infections. These include Nicholas Senn, Willis MacDonald, Allen Kanavel, Charles Peck, John B. Murphy, Russell Fowler, Rudolph Matas, Joseph Blake, George Brewer, Charles Scudder, and Carl Beck.

THE SECOND DECADE OF THE PUBLICATION OF "SURGERY, GYNECOLOGY AND OBSTETRICS" (1915–1924)

By far the most important step in the control of infections in this second decade was the result of the careful work of Dakin and Carrel (32). They began their studies at the Beaujon Hosptal in Paris in the laboratory of Professor Tuffier in the fall of 1914, but their work was soon transferred to the French Military Hospital No. 21 at Compiègne with a grant in aid from the Rockefeller Foundation. After examining about 200 substances, they came to the conclusion that chlorine compounds were the most potent germicides and Labarraque's solution (sodium hypochlorite) seemed the best of these. However, it was too alkaline and caustic to apply to tissues. When Dakin neutralized this with boric acid, he found that it was well tolerated. Carrel gave this new preparation the name "Dakin's solution." It had the quality not only of killing bacteria but also of dissolving dead tissue. However, its effect was so transient that in order to obtain the maximum result, the solution had to be delivered into the wound at frequent intervals. Later, Daufresne, one of the coworkers of Carrel and Dakin, modified the solution further to give it more stability. Carrel's objective was to prevent or stop infection in war wounds, to sterilize them, and to close them at the earliest opportunity.

The Carrel-Dakin technique was elaborate and had to be carried out meticulously in every detail to be successful. It required, first of all, thorough surgical débridement of the wound with the removal of all injured tissue and foreign bodies, and the opening up of every nook and cranny of the wound. Several small rubber tubes tied at the distal ends and perforated at centimeter intervals were carefully laid into the depths and various other parts of the wound and held in place with loosely packed fine meshed gauze. The surrounding skin was carefully protected by the application of vaseline-impregnated, fine-meshed gauze. The rubber tubes were then attached to glass distributing tubes connected with a container of Dakin's solution which in turn was attached to the bed. Sufficient solution was allowed to run into the wound every 2 hours to flush the wound surfaces. The dressings were changed completely every day under strict operating room aseptic technique and bacterial counts were made daily or at other frequent intervals. When these counts were virtually down to zero and there were no clinical signs of infection, the wounds could be sutured secondarily with success in the great majority of cases unless hemolytic streptococci were present. Failures resulted from a misunderstanding of the underlying principles, carelessness in carrying out every step in the technique, or faulty preparation of the solution.

It became necessary for Carrel (33) to point out repeatedly the correct method of preparing the solution, which had to be neutral and contain a content of sodium hypochlorite between 0.45 and 0.5 per cent. It had to be made up fresh daily, kept in brown bottles, and tested each day for neutrality to powdered phenolphthalein before use.

When the United States entered the war in April of 1917, Carrel came back to the Rockefeller Institute Hospital in New York and conducted a series of 2 week training periods in the practical application of this technique for a succession of Army surgeons. This was of infinite value to the proper use and success of the method throughout the First World War. Perhaps the most conspicuous cause of failure of this procedure was too great a reliance on the antiseptic qualities of Dakin's solution with the expectation

that it could take the place of the proper primary surgical treatment of the wound. It was recognized by no one more than by Carrel himself that it was an adjunct and not a replacement of surgery. While some gave it up because of its limitations, others, as exemplified by McCartney and Mewburn (34) in England, by Sherman (35), Fuller (36), and Loewy (37) in the United States, and by Baker (38) in Canada, continued to sing its praises. As a matter of fact, Dakin's solution proved to be the best antiseptic available for the local treatment of wounds for the next 2 decades. Dakin (39), himself, recommended a modification of his solution, which he called "dichloramine T." This was more stable and could be incorporated into oil, but clinically it was never as satisfactory as "Dakin's solution" itself.

With the entrance of the United States into World War I, reports in SURGERY, GYNECOLOGY AND OBSTETRICS took on military significance. Streptococcal empyema was a frequent complication of epidemic pneumonia in Army mobilization and training camps and was subjected to thorough and extensive study not only by certain individuals but by a special commission set up by the United States Army Medical Corps.

Moschcowitz (40), a member of this empyema commission, came to the following conclusions: "Empyema in most instances results from the rupture of a small subpleural pulmonary abscess. An empyema is the final stage of a process, in which the first stage is a serous pleurisy, and the second a seropurulent pleurisy. The latter is the so-called 'formative' stage of an empyema. The 'formative' stage of an empyema is unaccompanied by recent pleural adhesions. . . . The vast majority of [the cases of] empyema [are] of the encapsulated variety. [In] very few [cases does the exudate] occupy the entire pleural space. The treatment of empyema should be begun in the formative stage before the exudate has been converted into frank pus. It is unwise to perform an operation in the formative stage. The mortality is terrific, because the accompanying pneumonia is still in full bloom, and furthermore, because of the absence of adhesions there occurs an acute pneumothorax with 'fluttering of the mediastinum,' and consequent embarrassment of the action of the heart. The best surgical procedure in the formative stage is [to make] repeated aspirations, . . . as often as is indicated, in order to relieve the embarrassment due to mechanical pressure of the rapidly accumulating fluid. In a few cases this measure is even curative. Feeding with a diet rich in calories is an important adjuvant in the treatment of the formative stage. The treatment in the acute stage of empyema consists in simple intercostal thoracotomy. This operation need not be considered an urgent one, and should be performed when the patient's condition is otherwise perfectly satisfactory. This is the so-called 'late' operation. Urgent thoracotomy is indicated only in acute pyo-pneumothorax. The Carrel-Dakin treatment has proved of superlative value in the postoperative treatment of empyema, and should be instituted in every case. There are no contraindications to its use. The mortality of acute empyema by these methods is lower than reported by other methods of treatment. . . . Chronic empyema should not occur, or should at least become very rare, if the methods of treatment of acute empyema, as formulated above are practiced. 'Chronic' cases may, therefore, be defined as empyemata which are not amenable to treatment with Carrel-Dakin. . . . The vast majority of operations that have been devised for chronic empyema have a very limited field of usefulness, if the methods of treatment advocated above are carried out."

Schochet (41), however, did not favor the use of antiseptics in the treatment of empyema, saying, "they never supplant good common sense and good surgical principles," and taking it for granted that everyone knew what those were.

The war gave surgeons ample opportunity to make observations on the manifestations of gas gangrene. Davis (42) reported on what was then a new observation of considerable clinical importance—a halolike shadow about the missile demonstrated by roentgenograms, which indicated the activity of gas-forming organisms and the necessity for "urgent surgical interference."

In 1918, Wilensky (43) in INTERNATIONAL ABSTRACTS OF SURGERY summarized the experience of the British bacteriologists Douglas, Fleming, and Colebrook in studying cases of gas gangrene during the war. They noted, as Wilensky observed, that in the early stages of the infection, Bacillus perfringens, Bacillus oedematiens, and streptococci "make most of the trouble. . . . As the wound progresses, the anaerobes gradually disappear and . . . streptococci are responsible for all serious complications." These observers found that "Bacillus perfringens and strepto-

cocci, grown in symbiosis, result in a more abundant growth of each organism. When the culture also includes staphylococci, an enormous increase occurs in the cocci." Wilensky reported that the opinion was "frequently expressed that gas gangrene will not occur in the absence of muscle injury. . . . Macroscopic blood-vessel injury is common and frequently the main artery of the limb is torn and the resulting gangrene prepares the way for a massive gas infection." He noted that it had been observed clinically that "gas gangrene develops three times as frequently in wounds of the lower limbs. . . . Shell wounds are followed [by gas gangrene] six times as frequently as other injuries. . . . Sixty per cent of wounds with gas gangrene also had fractures. . . . Thirteen per cent had joint injuries. . . .

"Weinberg and Seguin worked very extensively with anaerobic organisms and determined that both the Welch bacillus and Bacillus oedematiens were aided very greatly by the Bacillus histolyticus in their growth and in the consequent spread of infection. . . . Bacillus sporogenes accomplished the same result in a similar way. Especially fatal is the symbiosis of perfringens and oedematiens organisms."

The many cases seen during the First World War gave Army doctors extensive clinical experience with gas gangrene with its prodromal symptoms of shock, gradual rise in temperature, a rapid pulse out of all proportion to the temperature, headache, malaise, anorexia, moderate swelling, gas in the tissues, a progressive brownish-coppery mottling of the skin, and a characteristic "mousy" odor. As Wilensky noted: "The final stage begins insidiously with a deepening of the stupor which is followed by a rapid overwhelming of the system."

Regarding treatment of gas gangrene, Wilensky (43) stated that "the absolutely essential steps . . . include: (a) the opening up completely of the entire wound including all pockets; (b) the removal of all dirt and the mechanical cleansing of the wound; (c) the removal of all foreign bodies; (d) the eradication of all haematomata, small and large; (e) the removal of all muscle tissue which is in any way compromised; (f) complete haemostasis. . . . In dealing with bone wounds, it is expedient to remove all bone fragments, those that are loose, or are thoroughly ground with dirt and other foreign matter. . . . It is imperative to institute wide and abundant drainage; and it has been found of great advantage to introduce some method of chemical and mechanical sterilization. Irrigation of the wounds is preferred, and Dakin's solution, applied after the method of Carrel, is the antiseptic of choice . . . . In a general way the question of amputation is to a great degree decided by the general surgical judgment of the surgeon. . . . Immediate amputation is indicated as a life-saving measure in the hyper-acute and rapidly spreading cases . . . . A number of sera have been prepared which have been employed in gas infections. At the beginning of the war, Weinberg and Seguin elaborated an antitoxic serum against bacillus perfringens. It showed some good results but was not entirely satisfactory and the belief was expressed that polyvalent serum, prepared with all of the organisms commonly encountered in the wounds, would probably be more efficacious . . . . In animals the protective qualities of Bull and Pritchett's antitoxin were marked and would neutralize the gas toxins in a manner very comparable in its efficiency to that of diphtheria antitoxin. . . . At the present writing this antitoxic serum seems to be the best of all so far prepared."

After the War, appendicitis continued to hold the interest of surgeons during the second decade. William Mayo (44) stressed the necessity for early operation in cases of appendicitis and stated editorially in SURGERY, GYNECOLOGY AND OBSTETRICS in February, 1922: "It is an axiom in surgery that early operation is vital in the treatment of acute perforation of the appendix, gall bladder, duodenum, and stomach, and almost always cures. In this early stage is the surgeon's 'golden opportunity,' not only to save the patient but to cure him. Experience has taught that if after the safe, early period has passed, the patient can be safely carried along for the several days of the intermediate stage, his natural resistance will usually succeed in limiting the peritonitis and localizing the infection. This is the surgeon's 'silver opportunity' to save the patient, by evacuating septic products although unfavorable conditions may prevent curative procedures. Much harm has resulted from the failure to recognize the difference between the stage of contamination which is the immediate result of perforation and can be successfully combated by early operation, and a spreading peritonitis resulting from the infection. The cause of the peritonitis is no longer the chief concern but rather the peritonitis itself. . . .

Ochsner, in practicing his starvation treatment of acute appendicitis and its results, first recognized the danger of operation in the stage between the safe early and the safe late stages of septic peritonitis related to appendicitis. . . . Clinical experience has crystallized our knowledge of septic peritonitis. We now see clearly that intestinal peristalsis is the chief factor in the spread of the infection. . . . If well-borne, proctoclysis is a good method of introducing fluid . . . . Moral: Surgeons will and operators should beware of operating in the intermediate stage of acute, septic, spreading peritonitis."

In another editorial in June, 1922, Mayo (45) pointed out again the danger of delay in operation after a perforation has taken place, when symptoms are quiescent before returning peristalsis rapidly spreads the fecal material around the peritoneal cavity. He called this quiescent period the period of "fatal improvement."

Rosenow (46) advanced the theory that appendicitis, ulcer of the stomach, cholecystitis, and pancreatitis, all may be due to the spread through the circulation of streptococci from the mouth, especially those resident in infections of the tonsils and teeth. This theory was not generally accepted nor was it well supported by experimental data.

Osteomyelitis was a favorite topic of the essayists of the second decade. Apparently there was a considerable difference of opinion among the surgeons regarding treatment. Two somewhat divergent but optimistic views were expressed by Clopton and by Simmons.

Malvern Clopton's (47) ideas of treatment were as follows: "The treatment in the acute stage is to drain to the center of the medulla by removing a narrow channel of bone along one side of the shaft. . . . It is best not to curette these cavities or to attempt to sterilize with antiseptics. . . . Where one bone of the forearm or leg is involved (and at times the humerus), . . . the shaft is removed subperiosteally about five or six weeks after draining the acute infection. . . . . After removing the shaft the periosteum is sutured into a ribbon joining the ends of the remaining bone, and from this periosteum new bone is formed to replace the diseased shaft. In the meantime the other bone supports the limb in its proper position. In about four months the new bone can support weight. The forearm can be useful in less time. In a small proportion of badly infected cases, bone does not regenerate completely after removal of the shaft, and bone transplantation has to be resorted to after healing is obtained."

Channing Simmons (48) reported on 97 consecutive cases of osteomyelitis as follows: "In general I believe a case of osteomyelitis seen and properly treated inside of a year from the onset of the disease should be cured . . . . . If the diagnosis is made at the onset of the disease and the bone operated upon at once, the prognosis is good except in the most severe cases of staphylococcic septicemia. . . . . In acute cases, open to the medulla and pack the wounds. . . . . In cases where bone destruction has taken place, seen less than three months after the onset of the disease, perform subperiosteal resection when possible. . . . . In chronic cases with bone destruction of less than one year's duration, remove sequestrum and pack. . . . . In old chronic cases, either with bone destruction or of the bone-abscess type, remove necrotic areas and drain. . . . . Try to obliterate the cavity with flaps of living tissue. If this cannot be done either use bone-wax, pack, or sterilize the cavity, allow it to fill with blood-clot, and close without drainage. The prognosis, if the cavity can be obliterated, is fair, otherwise poor."

Zapffe (49) supported the method which Murphy advocated in cases of acute septic arthritis, namely, aspiration and prompt injection of a solution of 2 per cent formaldehyde in glycerin followed by extension and complete rest until every evidence of inflammation had subsided. Zapffe also recommended vaccine, preferably of the autogenous type, saying that the treatment "is always followed by splendid results."

Postoperative pulmonary complications began to come under serious scrutiny for the first time in this second decade, with independent studies by Elliott Cutler and John Morton, and by Allen Whipple. Cutler and Morton (50) came to the following conclusions regarding the predisposition to postoperative pulmonary complications: "There seems to be present always a large and varying number of factors. Anaesthesia has been repeatedly blamed as the main factor responsible for these complications, but we feel we have shown that when alone and in good hands it can be disregarded as sufficient to bring about such sequelae. . . . The predisposing factors are: Poor general condition, i.e., age, anaemia, alcoholism, arteriosclerosis, weak heart or susceptible

lungs, carious teeth, septic tonsils. Pre-existing lung pathology—not only tuberculosis but bronchitis, emphysema or a recently subsided pneumonia. Anaesthetic badly given, i.e., forced, aspiration of mucus permitted, unnecessary intubation of nasopharynx, vomiting on table, etc. The presence of septic foci. . . . Operations in the epigastrium carry the added danger of lung complication through ease of vascular and lymphatic extension. Exposure to cooling fluids or to draughts (vasomotor disturbance). Postoperative pain resulting in hypostasis from poor expansion." They suggested certain prophylactic measures against these postoperative pulmonary complications, namely: "Careful preparation of the mouth; all oral sepsis from teeth and tonsils eradicated, antiseptic mouth wash and extra careful brushing of the teeth the day of operation. . . . . Observation of patient for at least two days before operation to insure absence of lung pathology and septic foci. Carefully administered anaesthesia, preferably in the hands of an expert; ether to be given by the drop method. Avoidance of mechanical appliances in mouth and nose unless indicated. . . . Avoidance of exposure during preparation on the table; no unnecessary wetting, plenty of blankets. Again after operation, particular care to avoid exposure, plenty of blankets, and if the patient is recumbent, these to be pinned about the neck. Operating room temperature kept above 75°F. The liberal use of hot wet packs in laparotomies in walling-off the operative field. Avoidance of trauma, especially in the epigastrium and in the neighborhood of large vessels. Asepsis. . . . . In addition, we advocate getting the patient up and out of bed just as early as is compatible with the existing conditions in each case."

Whipple (51), in an independent study, largely confirmed the opinions of Cutler and Morton. He stated: "Postoperative pneumonitis is a far more frequent complication than is acknowledged or reported. Its incidence in surgical services varies largely with the care given to its detection. These pneumonias are carelessly overlooked under the term 'postoperative reaction.' The most important predisposing factors are: a. Recent or concurrent inflammation of some part of the upper respiratory tract. b. Pulmonary congestion. c. Inhibition of normal respiratory movements or excursion as a result of abdominal incision. d. Debilitated states, such as sepsis and cachexia. e. Increase of the numbers and virulence of the pneumococcus during the winter and early spring. The most common inciting factor is the pneumococcus. Of the groups, the pneumococcus IV is the most frequently found in the patients' sputum. The patients in which the Group IV is the inciting factor develop agglutinins against the pneumococcus IV at some time between the seventh and fourteenth day after the onset of the complication. The pneumonitis caused by pneumococcus IV is, as a rule, an atypical pneumonia of short duration resolving by lysis and has a lower mortality than the Groups I, II, and III pneumonias or the pyogenic or septic pneumonias. The X-ray is a valuable aid in the early diagnosis of the complication. The lung shadow usually appears in the radiograph before frank signs of consolidation can be elicited."

THE THIRD DECADE OF THE PUBLICATION OF "SURGERY, GYNECOLOGY AND OBSTETRICS" (1925–1934)

The beginning of the third decade of the history of SURGERY, GYNECOLOGY AND OBSTETRICS found progress in the control of infections at a low ebb. The epoch-making work of Pasteur and Lister had demonstrated the importance of a knowledge of the science of bacteriology to the art of surgery and the basic principles of sterilization of materials for use in the operating room. Sterile technique on the part of the surgeon and his assistants had gradually evolved and had been generally accepted. This had opened up the field of surgery to such an extent that it became necessary to concentrate on developing refinements of operative techniques, and the departments of surgery and bacteriology, which should have maintained a close association, began to drift apart. At the Clinical Congress of the American College of Surgeons in October, 1927, the Centenary Anniversary of Lister's birth was celebrated and many tributes were paid to him and his achievements. Among others, W. W. Keen (52) and William Mayo (53) both paid honor to Pasteur and Lister. Mayo said that these great men had initiated the fourth epoch of medicine. He stressed the importance of the clinician carrying on studies in the basic sciences which apply to his work. Mayo predicted that the fifth epoch of medicine would reveal the secrets of metabolic processes.

Bloodgood (54) in 1916 had decried the divorce of bacteriology from surgery, stating:

"There is hardly a surgical clinic in this country today with an active and well developed bacteriological department. There are few, if any, trained surgical bacteriologists in this country. We have apparently lost interest in infected wounds and in the bacteriology of infectious diseases. . . . It is quite true that Wright's investigations on surgical infections with the development of the opsonic index and vaccines, created tremendous interest, but apparently the consensus of opinion is that the vaccine treatment for infections has failed. . . . Surgeons are apparently almost powerless in the combat against all general infections and types of infection like erysipelas and thrombophlebitis. Even the successful surgical therapy of local infection is by no means satisfactory. Large incisions and free drainage lead to fixed tendons, ankylosed joints, scar contraction and peritoneal adhesions. To cure an infection by amputation cannot be looked upon as a great triumph. It seems strange that after the splendid achievements of aseptic surgery, the development of anesthesia, the low operative mortality, and the great improvement of ultimate results, no surgeon or great surgical clinic could take interest in. . . . [surgical infections]."

Allen O. Whipple (55) had stated in 1919 that surgeons in the past had been anatomists, but that they were beginning to see the value of understanding surgical pathology, and that the surgeons of the future would be bacteriologists, physiologists, and chemists. Whipple and Hans Zinsser conceived the idea of setting up a laboratory for bacteriological research in the Department of Surgery at Columbia University, to create a strong link between the departments of surgery and bacteriology so that some of the basic knowledge in the field of bacteriology and immunology could be applied to the unsolved problems of infection met with every day or from time to time in the surgical wards of the hospital. The laboratory which Whipple and Zinsser conceived was finally established in 1925 and the author was asked to be its first director.

During this middle decade of the history of SURGERY, GYNECOLOGY AND OBSTETRICS, similar units were organized by Longacre at Tulane, by Lockwood at the University of Pennsylvania, by Lyons at Harvard and the Massachusetts General Hospital, and by Altemeier at the University of Cincinnati. These units applied themselves to routine and emergency work, as well as to special and general research (56). By so doing, they sought to reduce the incidence of postoperative wound infection by a continuous control of operating room technique, and to solve by systematic attack the major bacteriological problems of surgery. These included infections caused by the hemolytic streptococcus and by the hemolytic Staphylococcus aureus, and infections caused by mixtures of organisms, such as peritonitis and gas gangrene. The First World War had stimulated interest in anaerobic infections in gunshot wounds, and surgeons began to realize that the anaerobes and microaerophilic organisms played an important role in many surgical infections seen in the everyday practice of surgery, particularly in such disorders as peritonitis, lung abscess, human bites, and infections following severe accidental wounds of the soft parts and compound fractures. It also became apparent during this decade that infections like peritonitis and overwhelming septicemias caused profound physiological disturbances.

Wilkie (57) was among the first to call attention to the fact that "there are two separate and essentially different acute diseases of the appendix—the one acute inflammation of its wall, the other acute obstruction of its lumen." He felt that these should be more clearly differentiated. He wrote in 1927: "Acute appendicitis is an acute infection of the wall of the appendix and is of common occurrence and gives rise to symptoms, constitutional in type, such as might be anticipated in a lesion primarily infective—thus malaise, loss of appetite, rise of temperature and pulse rate, coated tongue, epigastric discomfort, often amounting to pain, sometimes vomiting, and later some rigidity and tenderness in the right iliac fossa. The milder degrees of this disease must often come and go without the physician being called on either for diagnosis or treatment." On the other hand, for acute appendicular obstruction Wilkie believed "a preceding attack of inflammation is usually responsible. A stenosis near the proximal end of the appendix has compromised the free ingress and egress of faecal matter. A portion of retained faecal content hardens to form a concretion, and then at some time, usually without warning, the peristaltic action of the appendix drives the concretion into the narrow stenosed area and there impacts it. The appendix is now completely obstructed. . . . Immediate operation with a free abdominal incision, so that the distended appen-

dix may be freely exposed to view, delivered and removed without rupture, is the only rational treatment. If the appendix is removed without perforation, even though it be gangrenous, no peritoneal drainage is necessary." Wilkie emphasized that "there can now be no doubt that when acute disease of the appendix is diagnosed in its early stages, immediate operation should be carried out. This is the only safe rule for general application."

Following a review of 3,913 operative cases, J. M. T. Finney, Jr. (58) brought statistical evidence to bear upon the question of early operation for appendicitis. Said he: "It would seem to us much better to remove a half a dozen relatively normal appendices by emergency operations, than to be responsible for the consequences which may attend waiting too long on one. We fully realize that the statement just made may sound very radical to some, but again we can show that the figures back us up. In the chronic group, out of 827 cases there was 1 death —a mortality rate of 0.12 per cent; in the 731 recurrents, 1 death, or 0.14 per cent; and in 548 subacutes, not a single death. In other words, by prophylactic or early operation, we can offer the patient a mortality rate—2,106 cases with 2 deaths—of 0.095 per cent. Over against this, if the attack proceeds to the acute gangrenous stage, while the chances are still good—1,129 cases with 16 deaths, mortality rate 1.42 per cent—the risk has been increased approximately fifteen times—and the appendix still not ruptured. Next in the abscess group—438 cases with 20 deaths, a mortality rate of 4.57 per cent —the danger increases again by more than three times. And finally in the peritonitis group —240 cases with 53 deaths, a mortality rate of 22.08 per cent—we multiply the chance taken by five, a total increase over the early groups of more than 225 times. Is it worth the risk, when the best the patient can look forward to, if that particular attack does subside under expectant treatment, is the probability of another later one—time, place, and circumstances unknown —plus the ever present chance that the current attack will not subside anyhow? It really seems to us that, paradoxically, the radical stand is the more conservative." Thus, decade after decade, the surgeons' advice has been to operate early as soon as the diagnosis of appendicitis is made. When will the family doctor and the internist fully accept their responsibility in this matter?

Osteomyelitis continued to be a problem with which the surgeons tried to cope. Doran and Brown (59) voiced the opinion of most surgeons regarding acute hematogenous osteomyelitis when they stated: "The necessity of early diagnosis and proper surgical treatment cannot be too vigorously advocated. Too few of the cases in this series [71 cases] were recognized as osteomyelitis in the early stage when proper surgical intervention would have promised a short convalescence. The majority of these that did receive early care recovered within 4 months, on the average. Early surgical treatment is the only means of reducing the morbidity and mortality. If sufficient drainage is instituted in the early stages, destruction of the cortex is avoided and convalescence is short. If the time from onset to operation is measured in hours, the convalescence is measured in weeks; if measured in days, the convalescence is measured in months or years."

Cutting (60) agreed by saying in a report some years later: "Acute osteomyelitis is a surgical emergency as acute as any emergency known to surgery. Minutes count in getting the patient to a place where he can be operated upon. General practitioners usually see cases of osteomyelitis first, and upon them, therefore, usually rests the responsibility of early diagnosis. Since mistakes in diagnosis usually arise from the practitioner's failure to think of the possibility of the condition, its essential features should frequently be brought to the attention of the profession at large. If, in a given case, there is doubt as to whether operation should be performed or not, a safe rule to follow is, to paraphrase an aphorism coined with respect to drainage in abdominal surgery, 'when in doubt, operate.' . . . Mere opening of the periosteum after the superficial tissues have been cut through is probably never enough. Whether pus is found or not, multiple drill holes should be cut into the cortex over the metaphysis, and even then the absence of frank pus does not necessarily mean a mistake in diagnosis if the case is an early one. . . . It is far better to perform the operation for osteomyelitis under unfavorable conditions than to risk any considerable delay incident to transportation of the patient to a distance with consequent loss of a number of hours of valuable time."

Chronic osteomyelitis was a problem not readily solved. In 1926, Bauman and Campbell (61)

advocated resection of the long bones so involved. They said: "The management of chronic osteomyelitis is probably one of the most discouraging aspects of the practice of surgery. The disease so resists treatment that the unfortunate subjects undergo large numbers of operations without eventual cure and often carry discharging sinuses through a long period of their lives. Resection of the diseased bone has been advocated by several. . . . Our resections have been performed, with one or two exceptions, upon cases of chronic osteomyelitis which have had discharging sinuses from 4 months to as many years. The technique has been to resect as much of the diaphysis as has been diseased and to sew the periosteal edges together over perforated rubber drainage tubes, allowing the tubes to protrude from either end of the incision. . . . Dakin irrigations have been carried out by means of the tubes and they have been allowed to remain for 2 to 5 weeks, depending upon the duration and character of the discharge. Regeneration of the bone has proceeded in most cases with surprising rapidity and the patients have attained a complete functional cure with but little deformity of shortening. . . . With a somewhat more judicious selection of cases and some improvements in technique, we believe that failure to completely regenerate should not occur in more than 10 per cent of all cases of resection. A cure of the infection should occur in practically every case after one operation. In cases of multiple chronic osteomyelitis some of the foci, which one might term 'secondary,' appear to be well localized. It is not necessary to resect the shaft to cure such a focus."

Baer (62) and, in his support, Buchman and Blair (63) advocated the use of maggots to favor the control of infection in the treatment of chronic osteomyelitis after the removal of the dead bone. They reported excellent results, but in most hands Dakin's solution proved to be more effective in preventing the re-establishment of infection in the remaining bone after the dead tissue has been removed.

Ehrlich (64), following his experience with dyes, had in 1913 predicted great expansion in the field of chemotherapy in the control of infections, but his death in 1915 had brought an end to his own researches in this field and most of his successors had soon become discouraged. They had come to the conclusion that the organs and tissues of the body would be more susceptible to the chemical disinfectants than the organisms themselves and that any internal administration of such chemicals would kill the host before it reached the offending organisms. Hata (65), a close associate of Ehrlich, believed that chemotherapeutic agents would only be successful in combating disease within the body, if they could act in the presence of body fluids and did not injure body cells. Browning (66) in England, who had previously worked with Ehrlich, became one of the chief advocates of dye therapy, particularly for local application in wound infections, but Fleming (67) warned against their danger because of their deleterious action on leukocytes and body cells.

Nevertheless, from these studies three dyes emerged which were given extensive clinical trial, namely, mercurochrome, gentian violet, and acriflavine. Some favorable reports appeared in the surgical literature, but gradually evidence began to accumulate that these dyes were not only ineffective but positively harmful (68). Finally, deaths were attributed to them and they gradually fell into disrepute. However, certain individuals, not to be discouraged by repeated failures with the dyes as antibacterial agents, continued their researches and one of them, Domagk (69), finally discovered prontosil, an active antistreptococcal agent relatively harmless to human tissues and organs. This opened up the field of the sulfonamides, which had their greatest success in the next decade of the half-century we are considering. Discussion of the sulfonamides will be brought in later in this report.

In 1926 the author (70) demonstrated the necessity of masking adequately the nose as well as the mouth of the surgeon and his staff, including the anesthetist. He showed by unquestionable cross-absorption of agglutinin tests that a hemolytic streptococcal wound infection in a hernial repair was caused by an organism serologically identical with that which was found in the nose of an instrument nurse and different from that which was found in the patient's own nose and throat, and different also from another found in the throat of a second member of the operative team.

In the same year, the routine use of anaerobic as well as aerobic methods of bacterial cultivation in the study of surgical infections revealed the cause of a peculiar form of progressive gangrene of the skin of the abdominal wall (71)

(72). It was found to require the combined action of two organisms, a microaerophilic nonhemolytic streptococcus and a hemolytic Staphylococcus aureus. This was confirmed by animal studies and borne out in subsequent clinical cases. It was therefore given the name "progressive bacterial synergistic gangrene."

Early in this third decade, the bacteriological study of the last of a series of 5 fatal postoperative infections yielded a new pathogenic clostridium of the gas gangrene group of organisms. A similar organism was found in two tubes from the same lot of catgut used in this fatal case (73). This led to a study of the methods of catgut sterilization (74, 75) and resulted in safeguards set up in the form of tests for catgut sterility which were approved by the Food and Drug Administration and the United States Pharmacopeia.

In 1932 it was demonstrated experimentally (76) that the three groups of organisms commonly found in peritoneal exudates, namely, the coliform, the intestinal streptococcus and the Clostridium welchii, play a synergistic role and increase the severity of peritoneal infections.

During the later years of this third decade, the role of bacteriophage in the control of certain infections seemed to be taking on increasing importance, causing d'Herelle (77) to coin the expression "the infectiousness of health." The idea was that phages able to control all kinds of diseases could be spread around extensively among members of a community and thus reduce the incidence of disease. D'Herelle's reports aroused great interest among bacteriologists and immunologists and in the 1920's and 1930's an increasing number of reports on bacteriophage appeared in the medical literature. For certain surgical infections bacteriophage seemed to be particularly adaptable, namely, for staphylococcal and Escherichia coli infections. The difficulties lay in bringing the bacteriophage in a potent state into intimate contact with the organisms. This will be referred to again in the next section.

In the meantime, Fleming (78), continuing his search for some agent which would be potent against bacteria without injuring leukocytes or other body tissues, accidentally discovered penicillin in 1927. He published his first report in 1929, but the full significance of his discovery was not generally recognized until 10 years later, and penicillin did not reach its fullest development until the fifth decade of this review, as will be described.

THE FOURTH DECADE OF THE PUBLICATION OF "SURGERY, GYNECOLOGY AND OBSTETRICS" (1935–1944)

Although Domagk (69) reported his researches in 1935 on the azo dyes, which finally yielded a whole series of sulfonamide compounds, the full significance of his discovery was not appreciated until the latter half of this fourth decade.

In the first half, surgeons interested in the control of surgical infections were still concerned with the problems of sterile operating room procedures and operating techniques. The chief sources of contamination of clean operative wounds were demonstrated to be the noses, throats, and hands of the operating personnel, the skin of the patient, the air of the operating room, and the instruments and materials used in the operation (79). Ways and means could be found for minimizing, but not for completely removing, these sources. As Mason (80) and others pointed out, bacteria coming directly from a human environment were more dangerous than those which had survived for a time outside of the body. It was demonstrated conclusively (79, 81) that the incidence of infection was significantly less when silk rather than catgut was used as suture and ligature material, as advocated by Kocher and Halsted. This was explained not by the lack of sterility of catgut but by the reaction to an irritating foreign body in the presence of a certain inevitable degree of contamination in every operative wound.

In a round table conference led by Mont Reid and including Allen Whipple, Arthur Allen, Michael Mason, and Urban Maes, refinements of technique were emphasized: meticulous cleansing of the skin with soap and water before operation, without too much dependence upon skin antiseptics (80), sharp dissection with a minimum of trauma (82), complete hemostasis with a minimum of tissue included in the ligature, protection of skin edges, the removal of debris by gentle washing of the wound, without any antiseptics in the wound itself (83).

Air contamination in the operating room was found to be reduced by irradiation with ultraviolet light, as reported by Hart (84), by Kraissl (85), and by Hirshfeld (86).

In another symposium, the importance of a careful and continuous study of wound infection

and the co-operation of a laboratory were emphasized, in order to obtain accurate figures on the incidence of wound infection, to keep the surgical staff on the alert to avoid and correct breaks in technique, and to trace the sources and determine the causes when they could be found (87). An adequately equipped and staffed bacteriological laboratory in the surgical department was deemed to be essential for the proper study of surgical infections and in order to provide a sound basis for their prompt and proper treatment (88)— there being many unsolved problems in this field (89, 90).

One of these perennial problems was that of skin preparation, both for the surgeons' hands and for the operative field. In spite of many antiseptics advocated as a substitute for the iodine reported by Nicholas Senn (1) in the very first paper published in 1905 in SURGERY, GYNECOLOGY AND OBSTETRICS, nothing had been found superior to iodine until the last part of this decade, when dihydroxyhexachlorodiphenyl (G 11) was found in 1944 (91). This could be incorporated in soap, and it could materially reduce the bacterial flora of the skin and keep the count down for a considerable period of time.

During the first half of this decade, Ochsner and DeBakey (92) made a significant contribution to the study of subphrenic abscess when in 1938 they reviewed 3,583 cases collected from the medical literature and added 25 cases of their own. They stressed the importance of early diagnosis and surgical drainage without entering either the pleural or peritoneal cavity.

In 1939, Ochsner and DeBakey (93) made a thorough study of the surgical aspects of amebiasis, which may occur as intestinal lesions or extraintestinal lesions. The former include appendicitis, perforation with resulting peritonitis, massive hemorrhage, ameboma, cicatricial stenoses, and pseudopolyposis. The extraintestinal lesions include hepatic abscess, pleuropulmonary affections, cerebral abscess, cutaneous ulceration and abscess, splenic abscess, and genitourinary affections. The problem is to make the diagnosis early and avoid surgery, if possible, because the lesions usually respond to specific antiamebic therapy.

In 1936 Neuhof and Touroff (94), after a study of 250 cases of acute putrid lung abscess, brought out some new ideas about the treatment of this condition, advocating earlier drainage than had been practiced. They stressed the importance of determining the exact location of the abscess before operating by using both roentgenographic and bronchoscopic methods. They said: "The objective of operation is twofold: first, to provide adequate evacuation [by unroofing the abscess], and second, to secure free ventilation of the cavity in order that the existing anaerobic infection may be eradicated." In most cases the lung directly over the abscess is adherent to the chest wall and the abscess may be drained in one stage. The authors stress that "the incision must be placed directly over this area regardless of location." The abscess is first aspirated with syringe and needle, then unroofed and packed with iodoform gauze. "The remainder of the wound is lined with paraffin and packed with moist gauze." Daily dressings favored rapid healing of these abscess cavities.

The routine employment of anaerobic as well as aerobic methods of bacterial cultivation in studying surgical infections led to the discovery of the cause of a certain type of undermining burrowing ulcer of the skin (95), rarely seen, but of surgical importance because of its resistance to all types of local and systemic treatment and because its inexorable spread often continued for months or years, finally ending fatally by erosion into an important blood vessel. The causative organism was found to be a microaerophilic hemolytic streptococcus. The characteristic lesion usually developed in one of three ways: (1) as a postoperative wound infection following an operation on the abdomen or pelvis, (2) as an indolent wound following the drainage of a slowly developing lymphadenitis, or (3) as a nonhealing wound following an accidental break in the skin. In seeking for an oxidizing agent to which this organism might be susceptible, zinc peroxide was found and the author and his associates (96) discovered that this chemical was effective not only against the organism *in vitro* but, when applied to the surface of the ulcer, it promptly brought the infection under control. This was demonstrated again and again as similar cases came under treatment.

It was then found that zinc peroxide was an effective local antiseptic in all types of anaerobic infections when it could be brought into contact with them (97, 98), and was an effective deodorant, particularly in foul-smelling infections of dental origin and along the alimentary

tract, as well as in putrid empyemas and lung abscesses (99). It also proved to have a detoxifying effect on the toxins of the hemolytic streptococcus and the Welch (gas gangrene) bacillus (100).

During the early half of this decade surgeons were still concerned with the problem of peritonitis. Priestley (101) in 1936, following the lead of European surgeons, tried polyvalent anaerobic serum and colon bacillus serum and thought that he obtained significantly more favorable results. However, this was not conclusively demonstrated.

Herrick (102) in 1937 decried the high death rate of 15.2 per 100,000 of the population following appendicitis. He thought it was due to "delay, catharsis and morphine . . . the arch enemies of the patient" and to the fact that when the patient reached the hospital he was usually turned over to the most inexperienced surgeons on the staff.

A collective review by Harvey (103) of the significant literature on peritonitis written during the previous 6.5 years appeared in 1938. Among these studies, one of the most significant was that of Foss, who found that "the average duration of time between the onset of symptoms and the call of the doctor was seventy-four hours and the average time before admission, ninety-five hours. Only 7 per cent of the patients came . . . [to] the hospital in the first twenty-four hours and [only] 30 per cent in the first forty-eight hours. Those who died averaged four and a half days before surgical consultation and lived for an average of seven days after operation."

Harvey reported that "Molnar tried to settle the question of drainage by studying the exudate in cases of peritonitis following appendicitis. He stained the cells with Seyderhelm's supravital stain and based the criterion of drainage on the number of living as against the number of injured pus cells. Irrespective of the character of the pus or the number or nature of the contained bacteria, he suggested drainage when the number of injured cells exceeded 50 per cent."

Harvey noted: "Opinions with regard to conservative treatment for peritonitis as contrasted with prompt operative treatment still differ radically, but there is some indication that the conditions to which these treatments should be applied are becoming more clarified. . . . The principles are: to limit the spread and favor localization; to put the gastrointestinal tract at rest by giving nothing by mouth; and to aspirate the stomach and duodenum. . . . In general it may be stated that we have come to a better understanding of the profound physiological disturbances that go on in the presence of peritonitis. The fundamental requirements are (1) the re-establishment of a normal fluid and electrolyte balance before or as soon after operation as possible; (2) the removal of the distributing focus of bacterial propagation, and (3) the restoration of the peristaltic function of the gastrointestinal tract."

In discussing the serum therapy of peritonitis, Harvey noted that "mentioned in almost all reports are the surgeons' impressions of the unexpectedly smooth course of the serum-treated patients, the early return of bowel function, and lack of postoperative complications." He also reported that "a great deal of interest has been aroused by the report of Hans Havlicek, who in 1932 reported the treatment of 108 cases of peritonitis following appendicitis without a single death. . . . Havlicek uses the 'Laparophoslampe' with a Wood's filter which gives essentially a monochromatic light permitting line 366 to come through. This light is luminescent, and the visible rays and those which produce erythema and conjunctivitis are filtered out. The lamp hangs from the ceiling and can be directed on the operative field without interfering with the main source of luminous light or with the sterile technique. . . . The duration of exposure is not constant. In mild cases five minutes seemed to be enough; in severe cases ten minutes, and when the prognosis would ordinarily be extremely bad, these tissues were occasionally exposed for twenty-five minutes. . . . After exposure, the loops were restored to the peritoneal cavity and the abdomen was always closed without drainage, although in badly infected cases the abdominal wall was usually drained for from three to four days. Havlicek emphasized the importance of using local anesthesia. He let all but the very sick patients get up from the operating table and walk to their rooms, with no apparent bad results. He was impressed also by the absence of pain in the postoperative course. Furthermore, he never found in any of these cases any complications such as residual abscesses in the pelvis, the subphrenic space, or the liver, or, in any instance, pneumonia, embolism, thrombosis, or other complication."

This method of treatment never gained wide acceptance, however. Such perfect results seemed incredible.

In April of 1939, Newell (104) reported 61 cases of primary streptococcus and pneumococcus peritonitis in children, 1 case due to a hemolytic streptococcus in a 2 month old infant, who recovered with sulfanilamide therapy, and another due to a pneumococcus, in which the child recovered following the use of pneumococcus rabbit serum Type I. The former of these 2 cases was apparently the first case of hemolytic streptococcus peritonitis treated with sulfanilamide, and the patient was the youngest on record in the American literature to recover from this disease. Newell predicted that the high mortality in such cases would be reduced by the new treatment.

In 1941, Thompson, Brabson, and Walker (105) published one of the first reports on the intra-abdominal application of sulfanilamide in acute appendicitis. They stated: "Sulfanilamide was applied intra-abdominally in nearly all the patients during 1940 in whom there was real or doubtful involvement of the peritoneum by infection. Complications seemed less frequent and were less severe; the drug in the dosages used had no severe toxic effects generally and failed to show any destruction of tissues locally. The only local effect noticeable was the encouraging rapidity of healing." Their mortality for the preceding 5 years (1935 to 1939) was 0.53 per cent in the group of simple acute appendicitis and 11.2 per cent in the perforated appendicitis group. However, during 1940, 204 cases were treated (abscess 21, peritonitis 31, acute appendicitis 152) with "the impressive mortality rate of zero." These authors concluded that the dramatic reduction in their mortality rate was directly due to their use of sulfanilamide.

The use of sulfanilamide locally in cases of peritonitis was quickly taken up by other surgeons throughout the country and there were many reports, both favorable and unfavorable. In general the former greatly outnumbered the latter, but statistically significant figures could not be obtained because no one carried out two parallel series during the same period of time. Furthermore, during this period other safety measures of anteoperative and postoperative care were employed, which may have played an important role in the lowering of mortality. One of these was based on an appreciation of the importance of fluid and electrolyte balance, and another consisted in the use of the Miller-Abbott tube for deflating distended intestines.

In 1941, Rea (106) tried to demonstrate the value of sulfanilamide in experimental peritonitis in dogs, but his results were not statistically significant, and he observed: "Sulfanilamide would seem to be most effective in the preperitonitis stage. Once peritonitis has developed, its efficacy is much reduced." Regarding the use of sulfanilamide in the peritoneal cavity, he concluded: "(a) it is not indicated in clean cases; (b) it is most effective in the preperitonitis stage; (c) it is more effective if placed in the peritoneal cavity than if placed under the skin; (d) it is of relatively little value in cases of frank purulent peritonitis."

In 1942, Harvey (107) found that the mortality in dogs in cases of experimental peritonitis was significantly reduced by the postoperative enteral administration of sulfonamide drugs, especially sulfathiazole. He reported: "Enteral administration of sulfapyridine, sulfathiazole and, less definitely, of sulfanilamide, was followed by a striking lowering of mortality. In the case of sulfathiazole, the mortality fell to 8.3 per cent, compared to 87.5 per cent for the controls. The mortality with sulfapyridine was 37.5 per cent, with sulfanilamide 50 per cent." Harvey concluded: "On the basis of this evidence we recommend the use of the sulfonamides clinically but do not recommend the use of preoperative injections."

Staphylococcus septicemia with a mortality of 80 per cent in the first half of this decade was a serious problem for the surgeon because of its tendency to metastasize to all organs and tissues of the body, particularly to bone, and to produce vegetation on the heart valves. For that reason those who survived were often destined to carry their infection for many years with frequent flare-ups from quiescent foci. Joyner and Smith (108) in 1936, following the lead of Dolman (109) and others, advocated the use of staphylococcus antitoxin in acute osteomyelitis and staphylococcemia. They believed that the antitoxin was not "directly bacteriocidal but has an indirect bacteriocidal action by neutralizing the circulating toxin and thus removing the inhibition of the normal phagocytic activity of the leucocytes. Our studies suggest that the mechanism is of major importance since those patients who lost toxic symptoms following administration of

antitoxin, all showed an increase in the white blood cell count with a return to a more normal ratio of segmented to non-segmented polymorphonuclear leucocytes."

Until 1937 surgical septicemia due to the hemolytic Staphylococcus aureus, the hemolytic streptococcus, or the colon bacillus was almost constantly present on the surgical wards of any general hospital. Organisms which could be cultivated repeatedly from the blood indicated that some distributing focus was pouring them into the blood stream faster than the cellular elements of the blood and the reticuloendothelial system of the lungs and liver could destroy them. In 1938 the author (110) stressed the responsibility of the surgeon in handling these cases: "In the presence of a septicemia caused by the pyogenic or necrotizing organisms, it is the surgeon's responsibility to find and, if possible, eradicate the distributing focus, with the possibility ever in mind that there may be a suppurative phlebitis in the neighborhood of the focus requiring proximal ligation or excision. . . . If the distribution can be arrested, the organisms will rapidly disappear from the blood. If they continue, the surgeon is faced with the necessity of finding another focus or of tying off or excising an involved vein. He must never rest, however, until a succession of negative blood cultures assures him that the infection is at last under control."

Domagk's (69) discovery of prontosil in 1935 was followed up by two French investigators, the Trefouels (111), who demonstrated that the active principle in prontosil was the simpler chemical, sulfanilamide. Then Colebrook and Kenny (112) in England seized upon the opportunity of giving this new drug a severe test in a series of cases of hemolytic streptococcus puerperal sepsis. Colebrook was particularly cautious in avoiding any overenthusiastic claims, but his results clearly showed a significant reduction not only in the mortality but in the morbidity of that disease.

It was not long after this demonstration that sulfanilamide proved its effectiveness in other kinds of hemolytic streptococcus infections and, because of its cheapness and general availability, it was tried promiscuously against all types of infection and even in cases which were not infections at all. One often heard doctors say, "I didn't know what the patient had, so I gave him sulfanilamide." This promiscuous use of the drug was not without danger and soon reports began to appear in the medical literature of untoward reactions—fevers, rashes, bullous eruptions, and other allergic responses, including anaphylactic shock not infrequently fatal. However, one thing was certain, hemolytic streptococcal infections almost invariably responded to this new drug and it was soon apparent that one of the chief bacterial enemies of the surgeon was about to be brought under control. One of the chief characteristics of hemolytic streptococcal infections is the diffuseness of the inflammatory process in the early stages, with a delayed breakdown of tissue and abscess formation. Administration of sulfanilamide in the early stages of the infection permitted it to reach the focus through the blood stream and often surgical procedures could be obviated. Furthermore, metastatic foci were prevented and septicemia was quickly terminated. Cases of cellulitis which formerly had gone on to septicemia with a fatal outcome in 50 to 70 per cent of the cases, subsided dramatically and hemolytic streptococcus septicemia practically disappeared from the surgical wards.

The discovery of sulfanilamide alerted all bacteriological laboratories to a new interest in the possibilities of chemotherapy. Experimentation went on in many centers in the attempt to determine the mechanism of the antibacterial action of the new drug and to find other derivatives which would work against organisms not affected by the parent drug itself. A number of Americans went abroad to work with Colebrook and find out what methods were being employed by him and his associates in this new field of investigation. Notable among these were Long, an internist from Johns Hopkins, and Lockwood, a surgeon from Columbia. Upon his return Lockwood joined the surgical staff of the University of Pennsylvania. Soon publications began to appear from the laboratories of both these investigators, helping to clarify our knowledge of these new drugs.

In the meanwhile the British investigators brought out the new derivatives, sulfapyridine and sulfathiazole, the former more potent against the pneumococcus and the latter said to be more potent against the staphylococcus than sulfanilamide. While these drugs were less toxic primarily than sulfanilamide, they sometimes had the untoward effect of forming crystals in the kidneys and a number of deaths from urinary retention were reported. Finally, one of the American commercial houses discovered a derivative which

was named "sulfadiazine." This only rarely blocked the kidneys and it soon took the place of sulfapyridine and sulfathiazole for all infections except those due to the hemolytic streptococcus, for which sulfanilamide still seemed to be the drug of choice.

None of these derivatives, however, were dependable in the treatment of staphylococcal infections. Many patients with developing infections due to this organism failed to respond and septicemia with the hemolytic Staphylococcus aureus often developed in the face of sulfathiazole or sulfadiazine treatment. Important factors in this failure may have been the more rapid breakdown of tissue by the staphylococcus and inactivation of the drug by the proteoses and peptones in the injured tissues.

In the meantime, studies with bacteriophage resulted in an increase in the potency of that agent, which was effective against both of the other major types of surgical infections, namely, those due to the staphylococcus and those due to the colon bacillus. Jern (113) demonstrated that bacteriophage, to be effective in serious cases, had to be not only bacteriostatic but bactericidal, and that this could be shown *in vitro* before administration. Longacre (114) proved the effectiveness of this "doubly potent" bacteriophage in a series of staphylococcus septicemia cases, many of which had failed to respond to any of the sulfonamides. MacNeal (115) showed that potent bacteriophage could be propagated in a simple asparagin medium, thus avoiding some of the unfavorable features of other media. However, the problem of producing a potent bacteriophage commercially developed major difficulties, not only in propagating this antibacterial virus but in keeping it alive and potent long enough to permit its distribution.

In 1937, Lyons (116) suggested the possibility of stimulating antibacterial as well as antitoxic substances against the Staphylococcus aureus by the injection of vaccine from very young encapsulated forms, but in actual practice this did not fulfill expectations. He also explained why it is that occasionally brilliant results are obtained by transfusion in cases of hemolytic streptococcus septicemia (117). He was able to determine by a special technique that about 1 donor in 10 or 20 will have potent natural opsonins for the patient's organism and that the donor's leukocytes will show a high degree of phagocytic power.

In the latter half of this fourth decade, the problems of World War II absorbed the interest of the medical profession both in this country and abroad. At the same time it became of urgent necessity to determine what effect the sulfonamides would have in reducing the mortality and morbidity of diseases that would be encountered by the armed forces distributed widely throughout the world—epidemic infectious diseases, tropical diseases, venereal diseases, and surgical infections in gunshot wounds and burns.

In 1940 the Surgeons General of the Army, Navy, and Public Health Service asked the National Research Council to help them evaluate these drugs in these various fields. There was some delay and it was not until late 1941, just before Pearl Harbor, that the Office of Scientific Research and Development was organized. A. N. Richards was made Chairman of the Committee on Medical Research, and soon research groups all over the country were hard at work trying to find the answers to the various medical problems engendered by the war. Lockwood (118) has given a comprehensive account of the accomplishments of this committee. A part of this work was carried out by a Subcommittee on Surgical Infections which set up a number of units throughout the country in various medical centers with complete bacteriological laboratories, to find out if the sulfonamide drugs could prevent infections in severe civilian accidental wounds of the soft parts and of bones, simulating war wounds, and in civilian burns. The problem was complicated, but certain criteria and a uniform program were set up and data were gathered which could be statistically analyzed concerning the use of these drugs.

Lockwood (119), who had investigated the mode of action of the sulfonamides, had come to the following conclusions: "Sulfonamide compounds produce their effects in infectious lesions by exercising a bacteriostatic effect on the organisms. This bacteriostatic effect is probably a result of a specific interference with the enzymatic utilization by the bacteria of some nutritive chemical factor, such as p-amino-benzoic acid. These substances, the utilization of which is blocked by sulfonamide, will act as inhibitors of sulfonamide effects when they are present in more than minimal concentrations. The curative effects of sulfonamides are maximal when the concentration of the drug is high, when the local cellular defense is active, and when the concen-

tration of sulfonamide inhibitors in the infected area is low. Localized areas of tissue necrosis and abscesses contain large quantities of sulfonamide inhibitor. The organisms within such lesions are protected against the effects of sulfonamides."

It was not surprising, therefore, that the study units all came to the same conclusion—that neither the local nor the systemic nor the combined treatment with the sulfonamides could prevent the development of infection in these severe forms of civilian injuries (120). When results from their use in war wounds at the battle front were carefully evaluated, unprejudiced observers came to the same conclusions. It was agreed by all that the sine qua non of preventing infection in these wounds was early and adequate débridement with removal of all dead and injured tissue and the maintenance of a good blood supply. It was also agreed that the sulfonamides minimized invasive infection by the hemolytic streptococcus and to a lesser degree by the staphylococcus from these wounds and so probably reduced mortality. As Lockwood (121) reported, it was possible also that local sulfonamide applications might "be useful in the first aid management of contaminated wounds between injury and definitive surgical treatment."

In 1944, Poth (122) reported that some of the later derivatives of the sulfonamide group, which were only slowly absorbed from the alimentary tract, had proved to be of benefit in certain intestinal infections and in cutting down the intestinal flora preliminary to intestinal surgery. However, these were to be superseded later by more potent agents to be mentioned.

Rene Dubos (123), in 1939, searching for an organism in the soil which might have some antibiotic action, discovered the "Bacillus brevis," a spore-forming aerobic bacillus, which produced a substance very potent against the pneumococcus and other gram-positive cocci. This was called tyrothricin and was further broken down into two constituents called gramicidin and tyrocidin. While they were effective *in vitro* and when applied locally to areas of infection, they had certain hemolytic and other toxic elements which prevented systemic administration and limited their usefulness. However, to Dubos should be given due credit for stimulating wide research in the antibiotic field.

The failure of the sulfonamides to measure up to expectations in the prevention of infections in war wounds led a group of British investigators, headed by Chain and Florey (124), to look elsewhere for more potent agents. They looked back to 1927, when Fleming (78) had discovered the activity of a substance produced by the mold Penicillium. With infinite labor and patience they produced enough of this substance to test out against certain desperate cases of staphylococcal infections. The response was encouraging and further tests indicated the importance of producing penicillin on a large scale. With Great Britain hard-pressed, the British pharmaceutical firms were not in a position to carry out this production and Florey came to the United States to seek help. The disappointing results obtained with the sulfonamides by the Subcommittee on Surgical Infections led this committee to endorse heartily the plan to go all out in penicillin production. Richards enlisted the aid of seventeen of the pharmaceutical houses and the Regional Laboratories of the Department of Agriculture. The War Production Board helped to mobilize all of this talent and soon the production of penicillin was in full swing. A small amount was made available to the research groups of the National Research Council and a backlog of supply was built up for the coming Allied military invasion of Europe. In 1943, Keefer (125) reported on the first 500 miscellaneous cases in which treatment with penicillin was given under the aegis of the Committee on Chemotherapeutics and Other Agents.

Lockwood (126) in 1944 gave a preliminary report from one of the civilian research units as follows: "Clinical studies on penicillin in surgical infections have been conducted during the past two years under the research program of the Committee on Chemotherapeutics and other Agents and the Subcommittee on Surgical Infections of the National Research Council. Authorization has been granted to issue a general statement of tentative conclusions which may be drawn from the authors' series of 440 cases. Penicillin, when administered systemically, modified the course of most infections in which the causative organism is sensitive to penicillin *in vitro*. The magnitude of the effect in individual cases may be roughly classified as follows: a. Dramatic curative responses in disseminated sepsis, particularly where circulation in localized distributing foci is adequate to effect contact between the drug and bacteria. In such cases surgical treatment which would have seemed un-

avoidable in the past may, with penicillin, be postponed or avoided altogether. b. Favorable responses characterized by subsidence of toxemia, correction of anemia, rapid healing of infected or seriously contaminated wounds, and elimination of infection within the pleural cavity or joints. . . . Careful bacteriologic studies are essential if penicillin is to be used with maximum effectiveness. As the supply of penicillin increases it will be possible through careful observation of cases, and the use of controls, whenever practical, to reach a more accurate definition of the scope and limitations of penicillin than is yet possible."

In discussing Lockwood's report, the author suggested certain criteria for the evaluation of drugs in the treatment of surgical infections as follows: "Drug therapy may be said to be effective in surgical infections, . . . (1) if it obviates the surgical procedure entirely; (2) if it permits a more limited type of surgical procedure than would otherwise be necessary; (3) if it permits primary closure immediately after removal of the dead tissue or exudate; (4) if it permits earlier secondary closure than usual; and (5) if it shortens the time of the control of the infection. . . . Penicillin has the very great advantage over the sulfonamides in that (1) its toxic limit . . . is far above its therapeutic level; (2) it is not inhibited by blood or pus or necrotic tissue; and (3) when used locally it minimizes . . . exudate. Penicillin has the disadvantage, however, of being inactivated or inhibited by many of the gram-negative bacilli, and of not working well when there are mixtures of organisms. In fact, its outstanding performance in surgical infections has been in those cases in which the causative organism has been the hemolytic Staphylococcus aureus, where the sulfonamides have fallen down so badly."

On this hopeful note ended the fourth decade of SURGERY, GYNECOLOGY AND OBSTETRICS's history—and this hope was more than fulfilled in the next decade.

THE FIFTH DECADE OF THE PUBLICATION OF "SURGERY, GYNECOLOGY AND OBSTETRICS" (1945–1954)

The fifth decade of the publication of SURGERY, GYNECOLOGY AND OBSTETRICS opened with great excitement in the field of bacteriology and its application to surgery. In fact, the history of surgical infections in this period is comprised almost solely of the story of the development and clinical application of a successive series of antibiotics.

At the beginning of this decade World War II was nearing its termination and the War Production Board had stockpiled the American and Allied Forces with penicillin in time for the invasion of North Africa, the blow on the "Soft Belly of Europe" through Italy and France, and the crossing of the English Channel. Florey (127) and his group, experimenting cautiously and conservatively, had demonstrated that penicillin could be applied to war wounds without injury to the local tissues and could be given systemically with apparent control of certain invasive infections. Reports of cases coming back to England from Normandy and Brittany were glowing in their praise of the use of penicillin and its superiority over the sulfonamides. "It was like a revival meeting," said one of the liaison medical officers (128). It is true that when reports came in from careful observers, it was not clear just what role penicillin played. Other factors seemed to be of primary importance; particularly, rapid nontraumatic transportation of the wounded to hospitals where proper débridement of the wounds could be done, nonclosure of wounds at the primary operation, and late primary or early secondary closure when it was evident that no invasion of bacteria was taking place (129, 130).

The distribution of penicillin to the American medical profession for the treatment of civilian infections in the early days of its limited production was in the hands of Chester Keefer of Boston, Chairman of the Committee on Chemotherapeutics and Other Agents of the National Research Council. Case histories from many sources were submitted to Keefer and 500 cases served as a basis for his first report in 1943 (125). These infections were both medical and surgical. A report on 744 cases of surgical infections, including 82 septicemias, was made in 1946 by the author (131), summarizing the cases treated by members of units in various cities working under the Subcommittee on Surgical Infections of the National Research Council. Some of the findings summarized in this report were as follows: "Penicillin is effective in controlling the disease either alone or as an aid to surgery in about two-thirds of the general run of established surgical infections. . . . It is more successful in the treatment of acute than of chronic infections and if given early rather than late in the course of the

disease. It is often effective when the sulfonamides have failed to control the infection. Many cases of well-localized surgical infection can be successfully treated with local injection of penicillin solution or local application of penicillin in ointment form. . . . Penicillin is not as successful in mixed infections as in those caused by a pure culture of a susceptible organism. . . . An analysis of the cases in which penicillin had no appreciable effect reveals the fact that in a large proportion of cases the cultures showed organisms capable of producing penicillinase."

It soon became obvious that penicillin, although it had great virtue and superiority over the sulfonamides, was not a panacea and had its limitations. It was superior to the sulfonamides because it was less toxic when given systemically. It was not only potent against the hemolytic streptococcus but against the second archenemy of the surgeon, the hemolytic Staphylococcus aureus. When applied locally even in high concentration (1,000 to 10,000 units per cubic centimeter), penicillin showed no local irritation to the tissues and was not inactivated by pus, slough, body fluids, or products of tissue breakdown as were the sulfonamides. It cut down purulent exudate instead of increasing exudate in the wound. It was active against most of the gram-positive organisms and was bactericidal rather than bacteriostatic.

Altemeier (132) and others found that if penicillin was administered early in cases of septicemia associated with acute osteomyelitis due to the Staphylococcus aureus, the blood could be quickly cleared of the organisms and the breakdown of bone prevented. In fact, hemolytic Staphylococcus aureus septicemia began to disappear from our wards soon after penicillin became generally available, just as hemolytic streptococcus septicemia had disappeared following the advent of sulfanilamide.

Jern (133) in 1945 demonstrated clearly that penicillin was superior to "doubly potent" bacteriophage and sulfathiazole in preserving the life of chick embryos infected with staphylococci, thus relegating bacteriophage and sulfathiazole to a position of secondary importance in the treatment of staphylococcal septicemia.

It was soon observed by Abraham and Chain (134) and others, who were among the first to work with penicillin, that certain organisms particularly among the large group of gram-negative bacilli had the power of producing a ferment which they called penicillinase and which had the power of inactivating or destroying penicillin. This was confirmed by Altemeier (135), but he found that this could sometimes be offset by the local use of high concentrations of penicillin. These penicillinase-producing organisms are commonly present in accidental civilian wounds and burns and are usually associated with the gas gangrene organisms in gunshot wounds. This fact seemed to explain the failure of penicillin to prevent the development of infection in many of the war wounds which had not been properly débrided and in gunshot wounds of the abdomen with bowel injury, for while these organisms are not very invasive, they propagate prodigiously on injured tissue and interfere with wound healing. This is true particularly of the colon bacillus, the Proteus group, and the Pseudomonas (pyocyaneus) group.

Clinically, many reporters found that combined therapy with penicillin and the sulfonamides seemed to yield better results than any of these antibacterial agents alone (136, 137).

The success of penicillin and also the demonstration of its limitations stirred up every laboratory to new enthusiasm in search of other antibacterial agents which might be expected to succeed where penicillin had failed.

In October, 1945, came the first report on bacitracin (138), which had been discovered in 1943 by Miss Balbina Johnson of the Bacteriological Research Laboratory of Columbia's Department of Surgery in one of the units set up for the appraisal of the sulfonamides in the prevention of infection in severe civilian accidental wounds. The organism producing this new antibiotic was a bacillus found in the débrided tissue from a compound fracture. The laboratory preparation and the early commercial product demonstrated the effectiveness of this antibiotic in controlling many surgical infections. When applied locally to infected ulcers or wounds, or injected locally into areas of cellulitis or into abscesses after aspiration of the exudate, bacitracin often obviated surgery (139). It proved to be effective in many cases failing to respond to penicillin and the sulfonamides. Bacitracin was found to be bactericidal and to have an antibacterial spectrum very similar to penicillin, and it had certain advantages over penicillin but one big disadvantage. It was not inhibited by any of the penicillinase-producers and was therefore more effective in mixed infections than penicillin. It

was slower in its elimination from the body and therefore could be given at longer intervals. It seldom gave allergic reactions, either primarily or secondarily. Organisms seldom or only very slowly developed resistance to it.

The first commercial preparation of bacitracin, grown on the surface of solid media, was of low toxicity when given intramuscularly up to 200,000 units a day. It produced a transient albuminuria, which usually disappeared with continued treatment (140). However, when attempts were made to produce it in large quantity, commercially in deep tanks, it was found that the nephrotoxic factor had increased and was disturbing (141, 142). This made it necessary to limit the intramuscular dosage to 100,000 units or less a day. Many surgical infections were brought under control with systemic doses of bacitracin totaling from 30,000 to 80,000 units a day (143). For a time, however, the chief benefits from bacitracin were obtained by its local application in the form of solutions or ointments in the treatment of surgical and dermatological infections. Later manufacturing methods by further purification reduced the toxic factor, and in 1950 the Food and Drug Administration released bacitracin for systemic use "in hospitals only." In 1953 this restriction was removed, so that now bacitracin may be freely used systemically, subject only to certain limitations as to dosage and careful watch of the fluid intake and output (144, 145).

The fact that penicillin was produced by a mold led to the study of other molds and fungi. The potentialities of this search offered a "field day" for the soil bacteriologists, who had labored long and inconspicuously in a field in which the chief interest had been noting the effects of various organisms and mixtures of organisms on the growth and development of plants. Under the able leadership of Selman Waksman, members of his laboratory staff at Rutgers, and certain commercial laboratories began a systematic study of soil organisms from specimens sent from all over the world. It was not long before scores, and later hundreds of antibiotic substances were found, but almost all of these had to be ruled out of any possibility of clinical usefulness because of their toxicity. As a matter of fact, it is surprising that any substance which interferes with the metabolism of any bacterium, causing its inhibition of growth or its death, would fail to have a similar effect on some body tissue cells.

It was found, however, that these antibiotic substances varied considerably in their toxicity as well as in their specificity for different organisms, and finally Waksman (146) found one in 1945 which seemed to fulfill the requirements and which he named "streptomycin." It was of low toxicity and had the great advantage of being effective against many of the gram-negative organisms and against the tubercle bacillus. This mycobacterium is the third archenemy of the surgeon because of its frequent and extensive destruction of body tissues and the production of surgical infections. It was soon found that streptomycin had some nephrotoxicity and a specific neurotoxic effect on the eighth cranial nerve. Furthermore, many organisms, particularly the gram-negative rods which were primarily susceptible to the antibiotic, very rapidly developed a resistance to it and in some instances actually grew better or even became dependent upon it for their rapid growth. This imposed a strange and highly important limitation to its usefulness, but in the course of time it was found that streptomycin had a synergistic effect when combined with penicillin or para-aminosalicylic acid (PAS) and that, when so combined, the development of resistance of organisms was often retarded. Most important of all, streptomycin stood out as the only antibiotic that gave clear-cut and consistent benefits when administered systemically in cases of tuberculosis, particularly in diffuse processes like meningitis or acute miliary tuberculosis. Likewise, the diffuse stages of the disease or the spread from old foci could be controlled with streptomycin, which rendered surgical removal of diseased tissue safer and more effective.

The early evaluation of streptomycin was carried out by many observers under the direction of Chester Keefer in 1946 (147). This new antibiotic was tried out against many different kinds of infections. Except for its unquestioned value in tuberculosis and tularemia, however, the results were somewhat equivocal. In general, streptomycin seemed to be of more value in medical than in surgical infections.

In order to obtain an appraisal of streptomycin in the treatment of surgical infections, a special unit was set up at the Army's Halloran Hospital in New York in 1946 under the direction of Captain Edwin J. Pulaski (148). Careful studies were made of the susceptibility of various organisms to streptomycin and the minimal inhibiting

concentrations were determined. These results were correlated with the clinical response to treatment. Pulaski and his coworkers found that doses of 0.5 gram of streptomycin given intramuscularly every 4 hours maintained blood serum levels in excess of 16 micrograms per cubic centimeter. There was no evidence that additional benefits accrued from doses in excess of 3 grams a day. They noted and reported that "bacteria rapidly acquire habituation to doses of streptomycin which were originally lethal. This phenomenon is most commonly observed during the treatment of urinary infections, and occurs either when sublethal doses of the drug are employed or with lethal concentrations of the drug in the presence of nonsterilizable foci of infections. The development of drug-fastness may be extraordinarily rapid, occurring in the urinary tract with as little as two days of therapy. Once it occurs, drug-fastness is irreversible, and drug-fast bacteria reproduce drug-fast bacteria. The change is specific and does not indicate concomitant resistance to other chemotherapeutic agents."

The further study of streptomycin in surgical infections was carried out extensively in Army hospitals by DeBakey and Pulaski (149) over a 10 month period: "Complete records were made and submitted to the Office of the Surgeon General. In the treatment of these cases, streptomycin was administered parenterally, locally, orally, or in combination, depending on the type of infection. For systemic administration, the intermittent intramuscular method is preferred. The dosage employed ranged from 1 to 3 Gm. per day, given at three or four hourly intervals. The larger doses generally proved to be more effective. In meningitis and empyema, doses of 50 to 250 mg. in sterile isotonic saline solution, administered once or twice daily into the spinal canal or pleural cavity, were used. For topical application, concentrations of 2.5 to 10 mg. per gram of medium were employed. The oral route was used in enteric infections with a total of 2 to 4 Gm. daily, given in divided doses, every six hours. Systemic administration of streptomycin in the doses cited was found to maintain therapeutically effective levels in blood and urine. Intrathecal and intrapleural administration proved essential for the effective treatment of infections involving the meninges and pleura, respectively. . . . In urinary tract infections due to susceptible bacteria, streptomycin has proved to be a very useful agent. Its successful use, however, depends upon a normal flow of urine. Recurrent urinary tract obstruction, urinary retention, and undrained or unsterilizable foci, including the prostate, predisposed to relapse or reinfection. Treatment under these circumstances produced rapid and irreversible drug-fastness. . . . Relatively extensive experience with streptomycin in wound infections showed that this agent is effective only as an adjunct to adequate surgery, and differs in no way from other chemotherapeutic agents with regard to its place in the surgical management of these conditions. . . . Streptomycin in peritonitis did not produce dramatic results. In bacteriemia due to streptomycin-sensitive organisms, highly impressive results were obtained. Essential to success, however, is eradication of the focus by surgical means. . . . *No striking results were obtained in those cases which are commonly considered surgical infections.* Vestibular disturbance was the only serious complication to streptomycin therapy and is the only one presently considered to be an indication for termination of therapy."

Pulaski (150) carried his studies further and recorded his observations on the use of streptomycin in peritonitis. He stated: "In early spreading peritonitis in which the infecting organism originates in the gastrointestinal tract, combined treatment with streptomycin and penicillin seems to offer no significant advantage over streptomycin alone. In the management of localizing lesions, on the other hand, combined therapy seems superior." However, Pulaski's results with peritonitis were not fully confirmed by Zintel (151) and his associates, and it has not yet been generally agreed what antibiotic or combination of antibiotics is the best treatment for peritonitis.

Paine, Murray, and Finland (152) studied the effects of streptomycin in both medical and surgical infections and drew the following conclusions: "Streptomycin has proved most effective in acute tularemia and in cases of meningitis due to gram-negative bacilli, especially Haemophilus influenzae. . . . It is at present the best available chemotherapeutic agent for tuberculous infections. . . . It may be useful as a second line of defense in some cases of coccal infections that prove insensitive to the sulfonamides and penicillin or develop fastness to these agents. The greatest limitation to the clinical usefulness of streptomycin is the readiness with which most

organisms develop resistance to it. Streptomycin is relatively nontoxic. The most serious untoward effect that has been noted is a disturbance in vestibular function. This effect has been observed mainly following the use of large amounts of the drug over prolonged periods."

The search continued for new antibiotics which would be more effective and less objectionable than those which had already been found. This research was carried out for the most part by pharmaceutical houses with large funds at their disposal. Such investigations are costly and the screening of all encouraging possibilities takes the time of expert observers. Many active agents were found, but they were too toxic for clinical trial. However, diligent search finally yielded, one after the other, chloromycetin (153) in 1947, aureomycin (154) in 1948, and terramycin (155) in 1950. These antibiotics were found to be relatively low in toxicity and to have a relatively wide range of activity, particularly against the gram-negative rods which had proved resistant to penicillin and bacitracin and which were able to build up resistance quickly to streptomycin. One great advantage of all three of these new antibiotics lies in the fact that they are absorbed from the alimentary tract and therefore can be administered by mouth. One disadvantage, as far as surgical infections are concerned, is that they are bacteriostatic and not bactericidal.

As soon as these three new agents were discovered and their relative safety determined, the respective manufacturers sought to have them given a clinical trial. Aureomycin was studied extensively at the Harlem Hospital in New York by Wright and his associates, in Minneapolis by Spink, in Boston by Finland and by Fine, and in Cincinnati by Altemeier. Wright (156) was particularly impressed by its curative value in lymphogranuloma venereum, noting prompt clinical improvement in a matter of days and disappearance of inclusion bodies from the aspirated material from buboes. Strax and Wright (157) in their enthusiasm stated: "In our hands aureomycin has exhibited bactericidal activity against a very wide spectrum of bacteria, rickettsiae, and viruses. It has replaced penicillin and the sulfonamides in the treatment of coccal infections and has supplanted the use of streptomycin in all bacillary infections except those of tuberculosis. It is most valuable in the preoperative and postoperative sterilization of the gastrointestinal tract in gastric or intestinal surgery and in the treatment of peritonitis, chronic nonspecific ulcerative colitis, and serious urinary infections." They were also impressed with chloromycetin and stated: "Chloromycetin is the drug of choice in the treatment of typhoid fever. Chloromycetin and aureomycin are equally effective in treatment of rickettsial infections and brucellosis. Chloromycetin is probably also effective in the sterilization of the gastrointestinal tract preoperatively and postoperatively. . . . Both aureomycin and chloromycetin have exhibited no important toxic manifestations."

In 1951 Wright, Schreiber, Metzger, and Parker (158) reported on the treatment of 235 consecutive cases of peritonitis with aureomycin. The following summarizes their results: "Aureomycin has been used as the sole antibiotic in the treatment of 235 consecutive unselected cases of peritonitis from all causes, with 22 deaths of which 7 can be considered due to a failure of the antibiotic. The antibiotic mortality rate [due to failure of aureomycin] was 3.18 per cent. The total mortality rate and the antibiotic mortality rate have been reduced by more than 50 per cent in several of the categories reported as compared with 2 previous years at Harlem Hospital when penicillin and streptomycin were the agents in use. . . . Aureomycin is administered intravenously in 500 milligram doses twice daily. Oral administration of a similar dose is begun as soon as gastrointestinal decompression can be discontinued. The dosage in children is proportionately less. . . . Aureomycin is considered to be the antibiotic of choice in the therapy of peritonitis."

Finland, Collins, Gocke, and Wells (159) had this to say about aureomycin in 1949: "The activity of this antibiotic seems to extend over a wider range of infectious agents than that of any of its predecessors. It is effective when given by mouth and has thus far been found to be essentially free of serious untoward effects. . . . Aureomycin is highly active *in vitro* against a wide range of pathogenic bacteria. . . . Strains of Pseudomonas aeruginosa and most strains of P. vulgaris appear to be the most resistant of the clinically significant bacterial pathogens. Against most gram-positive and gram-negative cocci it is definitely less active weight for weight than penicillin, while against most gram-negative bacilli it is less active than polymyxin and about equally as effective as streptomycin. . . . The experi-

ence with the use of aureomycin to date has indicated that it is effective in the treatment of a larger variety of infections than any previous agent. Except for gastrointestinal symptoms that may sometimes be bothersome, no serious toxic effects from its use have as yet been noted."

Spink (160) was cautious in his appraisal of aureomycin in 1949. He stated: "A decided advantage of aureomycin is that the antibiotic is effective in systemic disease when administered by mouth. It has been shown that following the administration, the drug diffuses into the pleural cavity, bile and cerebrospinal fluid. The drug also passes through the placenta and may be present in the fetal circulation. . . . When aureomycin is administered orally, nausea is encountered in some patients. Occasionally a patient may be unable to tolerate oral therapy because of vomiting. Epigastric distress has also occurred. The stools become soft, though not watery, and almost odorless. There may be some burning of the rectum. . . . We have not encountered blood dyscrasias, skin eruptions or fever due to the drug. The toxic effects of aureomycin to date have been minimal."

Fine (161) and his group looked favorably on aureomycin, but wrote of untoward side effects. Their experience indicated that "aureomycin was used in the treatment of 263 patients with a variety of surgical infections. Aureomycin was extremely effective in the suppression of the normal intestinal flora and gave excellent results in 67 cases of gastro-intestinal surgery. Aureomycin alone, or in combination with penicillin, was effective in the therapy of diffuse peritonitis due to intestinal bacteria. In patients with a variety of urinary infections, due chiefly to gram-negative bacilli, aureomycin therapy resulted in clinical and bacteriologic improvement in all and in cure in most cases, providing appropriate surgical treatment was applied whenever indicated. Aureomycin appeared to be beneficial in the control of biliary tract infections. . . . Postoperative wound infections responded very satisfactorily to aureomycin therapy. . . . Aureomycin was frequently effective in the treatment of infections which had failed to respond to other antibiotics. It was equally effective in mixed and in uni-microbial infections." Then, on a less favorable note, Fine and his coauthors wrote: "More recently we have encountered a number of patients who developed severe proctitis or colitis during oral aureomycin therapy. The accompanying diarrhea has been so severe and protracted as to impose a grave burden on the patients' fluid and electrolyte balance. In several instances the bowel mucosa was very edematous and the bowel muscle hyperirritable and in a state of almost continuous spasm. Several instances of stomatitis and esophagitis marked by dysphagia, substernal pain and 'burning' lasting for several weeks, have occurred. These untoward effects have also been observed during chloromycetin therapy. In several patients the colitis was manifest in excised bowel in the form of a pseudomembranous ulcerative colitis."

Altemeier and Culbertson (162), writing in 1951, were impressed by both aureomycin and chloromycetin in the treatment of many kinds of surgical infections.

Chloromycetin was found to have a range of activity similar to aureomycin, but it possessed the unique quality of potency against the typhoid bacillus. It could not, however, rid a typhoid carrier of his organisms. The manufacturers were able to analyze and synthetize this drug and the synthetic product could be made as cheaply as the biological. It was not long, however, before reports came in of cases of aplastic anemia following the use of chloromycetin, and fear of this complication limited its popularity inasmuch as other antibiotics could serve the same purposes. Chloromycetin was apparently more effective in medical than in surgical infections.

Terramycin, the next antibiotic to appear upon the scene, was very promptly applied to a wide variety of infections because of its broad antibacterial spectrum *in vitro*. It was soon found that its action was similar to that of aureomycin. In fact, organisms found to be primarily resistant to one or which developed resistance to one, were found to be resistant to the other. Terramycin not only had the same beneficial effects but the same untoward side effects as aureomycin. Further chemical analysis of these drugs demonstrated that they are similar chemically, aureomycin being chlortetracycline and terramycin, oxytetracycline. Tetracycline itself first became commercially available in November, 1953, (163), and the manufacturers of both aureomycin and terramycin have reported that tetracycline is just as effective clinically and has fewer side effects than either of the others. Clinical experience, however, has not been sufficient as yet to confirm that claim.

Although aureomycin, chloromycetin, and terramycin are potent against the pyogenic cocci and most of the gram-negative rods, the fact that they are all bacteriostatic rather than bactericidal requires the body to destroy the organisms after they have been held in check by the drugs. This may result in a masking of the infection which later flares up again when the drugs are discontinued. Such an effect is more likely to occur in surgical infections than in medical infections, because the former are characterized by a local breakdown of tissue resulting in a heavy concentration of organisms at the focus of infection and with a thrombosis of the blood vessels in the periphery of the lesion. This may prevent the penetration of the local process by the drug administered systemically in sufficient concentration to reach the organisms, and the protective mechanisms of the body may not be sufficient to destroy them. With medical infections, however, in which there is no local breakdown of tissue or thrombosis of the blood vessels, both the drug and the protective elements of the blood and tissues can reach the organisms wherever they happen to be. Furthermore, the body is less able to build up any real humoral immunity to the organisms causing surgical infections than to those causing medical infections. In general, therefore, it may be said that the triad of drugs—aureomycin, chloromycetin, terramycin—is more effective against medical infections than against surgical infections. Thus, it seems logical to use the bactericidal rather than the bacteriostatic antibiotics in the treatment of surgical infections when the causative organisms are susceptible.

The Second World War gave the opportunity for extensive studies on gas gangrene. However, it was found that the sulfonamides and penicillin did not measure up to expectations in the treatment of this condition, the former being inactivated by the broken-down tissues and the latter often being inactivated by the associated organisms producing penicillinase. It was said of penicillin in the treatment of gas gangrene in the Italian campaign that the drug permitted a more conservative amputation but could not save the extremity involved. This probably indicates that the amputation had to be done above the area where the penicillinase produced by the surface contaminants had its inhibiting effect. Penicillin could then take care of the more invasive gas gangrene organisms provided they had not already killed the involved muscle.

Sandusky and Keeble (164) in 1949 confirmed the earlier reports of Johnson and Meleney (138) that bacitracin could prevent as well as stop the development of experimental gas gangrene in animals. In 1950, both Sandusky (165) and his coworkers and Altemeier (166) and his group found that aureomycin and chloromycetin were also successful in the treatment of experimental gas gangrene in guinea pigs. Altemeier (167) had previously reported in 1947 that streptomycin had no significant therapeutic value, but penicillin had "a notable beneficial effect on the rate of development and the extensiveness of the infection as well as on the mortality" in experimental gas gangrene in animals (guinea pigs) obtained with a pure culture of Clostridium welchii.

Hac (168) had demonstrated the protective and curative value of penicillin in pure Clostridium welchii infections in mice in 1944.

Sachs (169) in 1945 wrote a collective review of the literature on gas gangrene and came to the conclusion that "the problem of gas gangrene remains unsolved. . . . Authors are agreed on the fundamental principle that early adequate debridement must be done in order to prevent gas gangrene. Amputation continues to be one of the most effective methods of combating the disease. . . . Results obtained by the use of serum either as a prophylactic or therapeutic agent are confusing. . . . Although it was rather difficult to evaluate the effectiveness of radiation therapy in percentages because of the many variable factors involved—such as the different types of therapeutic measures and combinations of these measures used,—it is the opinion of staff surgeons and radiologists that irradiation had been very beneficial and was a decided factor in both the lower mortality rate and the rate of recovery in the gas-gangrene cases treated at San Francisco County Hospital."

In 1945, Hall (170) carried out some rigidly controlled experiments with antitoxin in animals and wrote: "There is no reason to doubt the prophylactic value of seven American gas gangrene antitoxins against the anaerobic infections for which they were intended. . . . It is believed that the principal value of gas gangrene antitoxin is prophylactic, to prevent or delay anaerobic infections until adequate surgery can be secured, but that it also has definite though limited therapeutic value as an adjunct to sur-

gery in the treatment of malignant edema and gaseous gangrene in man."

The rapid development of gangrene of the muscle, often extending from a deep wound up to the origin or insertion of the muscle is characteristic of this disease. Such a development is seldom recognized quickly or easily by the clinical observer. Dead muscle certainly cannot be restored to life and offers the best medium for the propagation of the organism. One thing is certain, i.e., in cases of gas gangrene dead tissue *must* be removed surgically and that right quickly.

In 1947, Altemeier and Furste (171) summarized the treatment for gas gangrene as follows: "Radical surgery as soon after diagnosis as possible, consisting of multiple incisions for decompression and drainage of the fascial compartments, excision of the involved muscles, or open amputation when necessary, followed by immobilization of the affected part. Administration of polyvalent gas gangrene antitoxin before and after surgery—50,000 units every 4 to 6 hours as indicated to aid in the control of the toxemia. The injection of penicillin parenterally in very large doses up to 1,000,000 or more units every 3 hours before and after surgery to aid in the control of the infection. After its obvious control, the dose of penicillin may be gradually reduced. . . . The topical use of zinc peroxide ointment on wound surfaces after radical surgery." Altemeier concluded: "Early and adequate surgery is still the best method of treatment for either the prevention or control of gas gangrene. Chemotherapy has been shown to be a valuable adjunct to surgery, and penicillin in massive doses appears to be the agent of choice. The effectiveness of serotherapy both prophylactically and therapeutically is still disputed, but the evidence indicates that the early administration of the polyvalent type aids in the control of the toxemia when used in conjunction with the necessary surgery. The preliminary results of investigations with toxoid immunization of experimental animals are encouraging and suggest that effective prevention of this condition by the use of toxoid is a definite possibility." The work of Altemeier and Logan (172) and their coworkers in the preparation of toxoid for the gas gangrene organisms is encouraging and the toxoid may eventually be as effective in prophylaxis as the use of tetanus toxoid in the prevention of tetanus.

The availability and cheapness of penicillin in the early years of this fifth decade of the history of SURGERY, GYNECOLOGY AND OBSTETRICS led to its promiscuous and indiscriminate use by the medical profession in all types of infection and in other acute diseases not due to microorganisms at all. Now penicillin rather than sulfanilamide was given by the doctor when he "didn't know what the matter was with the patient." Nay, more, doctors were often *forced* to give penicillin when the patient would say, "Well, doctor, aren't you going to at least give me a shot of penicillin?"—intimating that if not, he would go elsewhere to someone who would. Sometimes patients would give it to themselves if the doctor refused.

This promiscuous use of penicillin had three very unhappy results. First, it made many patients allergic to the drug, so that subsequently when they may have needed it more, it produced very unpleasant and often dangerous, even fatal, reactions. In 1953, the Food and Drug Administration made a spot survey (173) to determine the number of acute anaphylactoid reactions attributable to penicillin and other antibiotics. The report disclosed "a total of 84 anaphylactoid reactions from penicillin, 24 of which were fatal" and none of which had ever been reported in the literature. Patients who survived these reactions would be pretty certain to tell a doctor of their experiences and would caution him against the repeated use of the drug, saying, "Don't give me penicillin. I can't take it." Secondly, this unwarranted use of penicillin would often delay administration of the proper treatment. Thirdly, it developed in the community strains of organisms which were resistant to penicillin. This applied principally to the hemolytic Staphylococcus aureus—the first important organism producing surgical infections to be brought under control by penicillin. During 1947, 1948, 1949, and 1950, laboratories all over Europe and America reported an increasing number of infections with strains of this organism which proved to be resistant to penicillin. In many instances these strains of staphylococci had developed the power to produce penicillinase. The ease with which staphylococci can get into and persist in the nose and nasal sinuses favors the development of carriers, who thus become wide distributors of penicillin-resistant staphylococci.

This phenomenon of the development of resistance to penicillin, as well as to streptomycin and later to the "broad spectrum" antibiotics, was studied extensively in the laboratory by Finland and others. In 1951, Finland (174) and his associates wrote: "We have been impressed with the recent increase in frequency and the relative importance of staphylococcal infections in the medical wards of the Boston City Hospital. . . . There has been an increasing proportion of penicillin-resistant staphylococci in cultures obtained from all sources, both from obviously infected foci and from routine nasopharyngeal and sputum cultures. Some of the staphylococci isolated during antibiotic therapy were associated with unusual manifestations of infection with this organism. In particular, some patients have been observed in whom scarlet fever complicated the antibiotic therapy of other infections and the scarlet fever was associated with the occurrence of hemolytic strains of Staphylococcus aureus and nonhemolytic streptococci. Even more interesting is the appearance of diarrhea associated with recovery of staphylococci in large numbers and sometimes in pure culture from the stools. . . . Hemolytic Staphylococcus aureus, coagulase-positive, has been recovered as the only or predominant organism in the lungs, blood and other organs in increasing proportions of autopsies. . . . What is more important is that these organisms have proved highly resistant to penicillin and a large proportion of them have been resistant to aureomycin and terramycin."

The author (175) and his laboratory associates have been increasingly concerned with the increasing resistance of organisms to the various antibiotics and have stressed the importance of the earliest possible determination of the susceptibility of every organism, both causative and secondary, in every case of surgical infection in order that the most potent antibiotic or combination of antibiotics may be used in the treatment of the case.

When the so-called "broad spectrum" antibiotics (aureomycin, chloromycetin and terramycin) appeared and their virtues were widely advertised by the manufacturers, the failure of penicillin to control many infections led the medical profession to turn to this new group of antibiotics. Soon they came to be used as indiscriminately and promiscuously as the sulfonamides and penicillin had been before them—and with the same unfortunate results. Organisms became increasingly resistant to these antibiotics, proper treatment was delayed, and patients became more and more allergic to them. Furthermore, because they were administered orally for the most part, the untoward effects in the alimentary tract became more numerous and more serious with protracted diarrhea, ulceration, and hemorrhage. Not infrequently fatal enteritis developed because of mycotic or resistant staphylococcal strains.

During this fifth decade, two other antibiotics of significance to the surgeon came to the fore, namely, polymyxin B (176) in 1947 and neomycin (177) in 1949. Polymyxin was found to have particular potency against the pyocyaneus group of organisms and was quite unique in that respect. Neomycin proved to be potent against the proteus group, the colon and aerobacter groups, and the staphylococci, but was surprisingly weak against streptococci and the clostridia. Both polymyxin B and neomycin are nephrotoxic when given systemically, neomycin more so than polymyxin B. Polymyxin B may be used systemically, however, in those rare cases when Pseudomonas aeruginosa invades the blood stream, when it has produced a severe urinary tract infection, or when other gram-negative rods are only susceptible to this antibiotic. If used systemically, the dosage of polymyxin should be limited to 20 milligrams every 4 to 8 hours and close watch should be kept for signs of kidney damage. Neomycin is not only nephrotoxic but is more neurotoxic for the eighth nerve than streptomycin, and the frequency and severity of the toxic effects of the neomycin presently available render its systemic administration too dangerous. Both of these antibiotics are bactericidal and for that reason are of particular value in surgical infections when they are applied locally to the area of involvement. They may be so used without toxic effects.

One of the most important areas of the body amenable to the local application of antibiotics is the alimentary canal, either for the treatment of infections in various portions of that tract or for the reduction or elimination of organisms normally present at certain operative sites along it. For the most effective results the antibiotics used should be bactericidal, not locally irritating, not absorbed from the tract or inactivated by the fluids or ferments that empty into it, and

not affected by changes in the hydrogen ion concentration, and they should retain their potency while they are being carried down the whole length of the canal. Bacitracin fulfills these requirements for the organisms of the mouth, esophagus, and stomach, and for the clostridia and streptococci of the lower bowel (145). Even with the gram-negative rods, bacitracin is inhibitory as long as it keeps its concentration at 1,000 units or more per cubic centimeter. However, against the gram-negative rods neomycin fulfills the requirements better, although it is relatively weak against the clostridia and intestinal cocci. While Poth (178) advocates the use of neomycin alone for intestinal antisepsis, the author believes that the combination of bacitracin and neomycin would seem to be more potent than either alone in controlling the mixture of organisms found along the alimentary canal. Moreover, it has been shown that these two antibiotics have a synergistic and not an antagonistic effect on one another.

Several other antibiotics have been produced in the last year or two of this decade. The most promising of these seems to be erythromycin. This drug can be given orally in tablet form. On several occasions it has successfully counteracted the severe staphylococcal enterocolitis resulting from one of the "broad spectrum" antibiotics (179).

This brings us to the question of the local versus the systemic use of antibiotics. Churchill (180) came back from World War II having had extensive experience with wounds in the Italian campaign. He expressed the opinion that there was no indication for the local use of antibacterial agents (penicillin and the sulfonamides being the only ones available at that time), with the possible exception of infections in the thoracic cavity and joints. Lyons (181), who had worked with Churchill during the war, wrote in 1948: "The surgical specialists of today are probably more skeptical than any other group of the therapeutic advantages of presently available antibacterial therapy. It is only natural that this should be so. The prerogative of treating infections responding solely to antibacterial agents has been usurped by the internist and general practitioner. The surgeon is consulted only when the infection is clinically persistent in spite of adequate chemotherapy or antibiotic therapy. Under such conditions it is usually possible for the surgeon to find an abscess, a focus of necrotic tissue, or an infected thrombus requiring surgical treatment. An important consequence of this clinical trend of altered responsibility is the development of fundamentally different philosophies regarding antibacterial therapy by the surgical and non-surgical specialists. . . . Even among surgeons there has been considerable controversy as to the merits of systemic chemotherapy as compared with topical applications. . . . At the moment the controversy seems to have been settled by the surgical experience of World War II. It has been established that local chemotherapy is not only unnecessary but frequently undesirable. . . . If the objective of chemotherapy is recognized as the protection of living tissues from the hazard of invasive infections, then the systemic route is the desirable method of treatment. Within such a concept of management of open wounds there is no place for topical applications of antibacterial agents."

On the basis of his own extensive experience with the local use of the bactericidal antibiotics, the author finds himself in disagreement with this point of view. It seems to him that Lyons has failed to take into account the pathology of surgical lesions with their local necrosis of tissue and purulent exudation. He may have been too much affected by his previous experience with the sulfonamides, for, as mentioned previously, certain of the antibiotics, particularly penicillin, bacitracin, polymyxin, and neomycin, can be applied locally to areas of surgical infection in concentrations far exceeding anything that can be reached with systemic administration. They are not inactivated by the local fluids or broken-down tissues as were the sulfonamides. They are bactericidal and therefore do not depend upon the local body tissues or general immunity to kill the organisms. They are absorbed locally to a degree, but without causing unfavorable systemic side effects, and altogether they bring the infection under control more quickly by the death of the organisms wherever they can reach them.

There should be no conflict of philosophies in connection with the treatment of surgical infections. Local treatment with antibiotics is indicated when it can be administered and when the disease is primarily local, and the antibiotics should be given systemically in the early stages of the infection before breakdown has occurred. They should be given systemically in addition

to the local use when there are systemic manifestations beyond the local area involved. In fact, with the use of an antibiotic potent against the organism involved, surgery may often be obviated or reduced in scope in conditions previously thought to be amenable only to surgery, and to radical surgery at that. This applies to furuncles, carbuncles, cellulitis, and superficial abscesses, and even to such destructive lesions as progressive bacterial synergistic gangrene. On the basis of extensive experience with the local and systemic use of the antibiotics, it may be justifiably stated that some of the principles that were formerly thought to be fundamental in the treatment of surgical infections have been changed by the advent of the antibiotics, particularly the bactericidal antibiotics. In many cases they have become a substitute for, and not simply an adjunct of, surgery.

Lockwood (182) in 1947 recognized that the advent of the antibiotics had modified some of the "fundamental principles" in the treatment of surgical infections and summarized it thus: "*Infections Which May Respond to Chemotherapy Alone:* 1. Cellulitis, lymphangitis, bacteremia; 2. Acute hematogenous osteomyelitis; 3. Suppurative arthritis; 4. Acute thoracopulmonary suppuration; 5. Spreading peritonitis; 6. Furuncles and carbuncles. . . . *Infections Which Certainly Require Both Chemotherapy and Surgery:* 1. Acute appendicitis with local peritonitis; 2. Chronic osteomyelitis; 3. Infections of the hand and foot, with or without diabetes; 4. Bronchiectasis; chronic empyema; pulmonary abscess; 5. Gas gangrene; 6. Chronic granulomas, including actinomycosis." He concluded: "The use of chemotherapeutic agents in surgical infections has developed along three principal lines: (1) preventive use, in which the drugs are employed to reduce the infectious hazards of surgical intervention in contaminated operative fields; (2) primary therapeutic use, in which logic and clinical experience justify principal reliance on chemotherapeutic control of the infection, with surgical procedures directed toward limited residual elements in the disease, and (3) secondary therapeutic use, in which surgical treatment remains the primary weapon and the antibacterial drugs serve only as helpful adjuncts during the preoperative and postoperative periods."

While many surgeons as well as medical men and general practitioners continue to use all of the antibiotics indiscriminately and without scientific bacteriological control, many serious investigators in this field are concerned with the serious problems that have arisen, and have been seeking to find their solution. Sir Alexander Fleming (183) predicted that the result of the indiscriminate use of penicillin would be the development of strains resistant to the drug, which would produce uncontrollable infections. This trend has, of course, been modified by the availability of the later antibiotics. Reference has already been made to the observations by Finland of the serious manifestations of staphylococcus infections due to penicillin-resistant staphylococci. It is in such circumstances that the local and systemic use of bacitracin and the local use of neomycin may solve individual cases and ameliorate the problem as a whole.

Spink (184) in 1953 noted some of the problems which have arisen in the field of antibiotic therapy. He wrote: "One or two basic therapeutic principles should govern the clinician in his use of the antibiotics. Either as a result of precise laboratory data or on the basis of adequate clinical experience, he can decide that a given patient is suffering from a specific infectious disease. Oftener than not information is available to determine whether an antibiotic is indicated in such a disease; if so, the antibiotic should be used that has been shown to be the most effective. Unfortunately, as simple and as sound as these principles are, many clinical problems are created by the indiscriminate use of the antibiotics in such situations. A current pernicious therapeutic philosophy is based on the following conclusions: 1. The antibiotics are highly effective for many common bacterial infections. 2. These drugs are readily available, inexpensive, easy to administer, and relatively nontoxic. 3. In cases in which the patient is febrile with the cause in doubt, before investigating the basic causes of the illness, therapy with an antibiotic should be attempted. In some instances a seriously ill patient is benefited by such a procedure, but in too many cases such an approach not only curtails the arrival at a correct diagnosis but may actually jeopardize the eventual recovery of a patient." Spink concluded: "The rapid and extraordinary achievements in the treatment of infectious diseases constitute one of the outstanding advancements of modern medicine. This field of inquiry will yield optimum results with the least harmful effects

for the patients, and for successful therapy of diseases due to viruses and fungi. It is difficult for the busy practitioner and for a hospital staff to keep up with the more recent developments. In order to crystallize the available information for practical purposes, it is suggested that each hospital staff, and especially the larger general hospitals, have a standing committee on chemotherapy for the purpose of evaluating and recommending standard procedures for the use of the antibiotics."

One of the dangers for the surgeon to guard against in the field of antibiotic therapy is the letting down of some of the basic rules relating to sterile operating room technique and the reopening of the doors to wound contamination at the time of operation. Another danger is that of counting too much on antibiotics to control infection by compromising on the surgical removal of dead and injured tissue and foreign bodies in badly contaminated civilian accidental wounds and war wounds. A third danger is that of being forgetful of some of the profound physiological disturbances which may take place during the course of any prolonged infection and which are present in many chronic conditions. These must be corrected by every means available. Conversely, the author has seen these physiological disturbances brought to an abrupt termination by the antibiotic lethal effect on locally multiplying and toxin-producing organisms.

And so we come to the fiftieth year of the publication of SURGERY, GYNECOLOGY AND OBSTETRICS, with many problems of surgical infection solved by the persistent search for antibacterial agents by keen observers whose "minds were prepared," as Pasteur put it, "to appreciate the significance of their observations," by the close collaboration of laboratory and clinic, and with the hearty co-operation of pharmaceutical houses. At the same time there has been a steadily progressive understanding of the physiological disturbances associated with surgical infection and measures have been discovered to counteract them and restore the normal physiology.

WITH REGARD TO THE NEXT HALF-CENTURY

As we begin the second half-century of the publication of SURGERY, GYNECOLOGY AND OBSTETRICS, there are still problems of infection to be solved, and a search must still be made for other antibacterial agents to strengthen the weak places in our defense against surgical infections. We need more potent and less toxic antibiotics against the proteus and pyocyaneus groups of organisms. We need to know more about the toxic and allergic effects of available antibiotics and we must find means to minimize and prevent their harmful effects. We need to know more about the synergism and antagonism of the antibiotics. We need a closer correlation between the laboratory and the clinic in every hospital so that the patient may have the fullest benefit possible from our present knowledge, from an earlier determination of the causative organism and its sensitivities, and from the prompter administration of the most potent antibiotic or mixture of antibiotics. Thus, infections will be brought under control in their earliest stages and will not go on to chronic states which are accompanied by profound physiological disturbances and which drain the physical and financial resources of the patient.

We cannot prevent infections from occurring before the patient sees the doctor, but we can more closely approach the goal set by the writer (185) more than 25 years ago, namely: "As long as surgical infections exist, surgeons must make never-ending efforts to control them and to prevent their occurrence by every means available. The goal is not yet in sight, but we know what it is and we believe it to be attainable. It may be described as *a time when medical science and art can absolutely prevent bacteria from gaining a foothold in the human body and can abruptly terminate their activity, if they have already become established.*"

In the future, as it has done in the past, may SURGERY, GYNECOLOGY AND OBSTETRICS present authoritative and constructive reports on timely medical and surgical problems, thus contributing to the accumulation of knowledge, the advancement of the surgical profession and the alleviation of human suffering!

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Cranial Aerocele. FRANKLIN JELSMA and DUDLEY F. MOORE. *Am. J. Surg.*, 1954, 87: 437.

THE authors review the literature and present 4 cases of cranial aerocele. Cranial aerocele is a spontaneous collection of gas, usually air, beneath the pericranium or within the skull, usually intracranial. It occurs most often as a complication of skull fracture or perforating injuries to the head, and as its development is delayed, the diagnosis of cranial aerocele usually comes as a surprise.

Extracranial aerocele (pneumatocele) is subperiosteal and may be frontal or occipital. Intracranial pneumocephalus may be extradural, subdural, subarachnoid, intraventricular, or intracerebral. The causes are penetrating wounds of skull, skull fracture with fistulous tracts, erosions due to tumors or infections, spontaneous, and postsurgical.

Clinically, the first consideration is the local injury, usually a compound fracture into the calvarium, sinuses, mastoid, or middle ear. In a large proportion of cases infection eventually develops, with meningitis, sometimes years later. Aerocele is usually associated with increased intracranial pressure, and there may be perceptible rhinorrhea. Pneumocysts are capable of producing focal signs and symptoms.

Treatment begins with the initial injury and is, therefore, preventive. Careful cleansing and debridement, complete hemostasis, closure of the dura, and tantalum cranioplasty will prevent most aeroceles. Antibiotics are desirable. Frontal sinus dead spaces must be obliterated. Definitive treatment differs with location, but in general consists of drainage of the usual abscess cavity in the brain, measures to combat infection, such as treatment with antibiotics, excision of the fistula, repair of the dura and scalp, and tantalum cranioplasty then or later. Should it be impossible to close the dura tightly, a seal of gelfoam impregnated with penicillin, whole blood, and thrombin is useful.

—*S. Lloyd Teitelman, M.D.*

The Treatment of Parotid Tumors by Irradiation and Surgery (Considerazioni sul trattamento radiochirurgico dei tumori della parotide). PIERO PALUMBO. Policlinico, sez. prat., 1954, 61: 550.

THE author summarizes the treatment of 25 tumors of the parotid gland by a combination of irradiation and surgery. He recommends close co-operation between the surgeon and the radiologist in determining the treatment of these tumors.

A classification of parotid tumors is presented. Benign tumors are considered as important factors in that they must be differentiated from malignant tumors. The classification is as follows: mixed tumors; carcinoma, (a) cylindroma, (b) adenocarcinoma, (c) squamous cell carcinoma, (d) undifferentiated carcinoma, (e) mixed carcinoma, and (f) malignant melanoma; sarcoma, (a) simple sarcoma, (b) angiosarcoma; carcinoma with mixed sarcoma, (a) adenocarcinoma with mixed sarcoma, (b) carcinoma, mixed sarcoma with squamous cell carcinoma; adenoma; lymphomatous tumors; cystadenoma papillary lymphomatosum (Warthin); and miscellaneous tumors.

The author believes that 40 to 50 per cent of the mixed tumors are potentially malignant and therefore should be treated adequately. In their opinion the greatest number of malignant tumors of the parotid gland are malignant transformations of so-called mixed tumors.

A small mass in the parotid area is usually the earliest sign of a parotid tumor. Later the patient may complain of a neuralgic type of pain. Disturbance of salivation is an uncommon symptom and involvement of the seventh nerve is usually a late sequela.

The authors comment on the need for irradiation therapy along with radical extirpation and contiguous en bloc neck dissection. They believe that the chances for cure are enhanced by preoperative and postoperative irradiation in selected cases. Preliminary irradiation is given according to the sensitivity of the tumor. Medium dosage is used if the tumor is to be surgically excised. Maximum dosage is used if the tumor is radiosensitive and malignant. Three ports are used: anterior oblique, posterior oblique, and lateral. The dosage varies from 2,400 to 4,000 roentgens. Radium therapy is advocated in dosage varying from a minimum of 180 m.c.d. to a maximum of 600 m.c.d. —*Frank W. Pirruccello, M.D.*

EYE

The Corneoscleral Suture; A Technical Modification. H. B. STALLARD. *Brit. J. Ophth.*, 1954, 38: 232.

THE author discusses the relative merits of the various types of corneoscleral sutures.

This type of suture is recognized as important, not only in the prevention of serious complications at operation but also after the cataract has been extracted, because it assists in the healing and firm closure of the section.

In order to avoid epithelialization of the corneal edges and the anterior chamber, deep necrosis, cystoid cicatrix, cicatricial ectasia, peripheral synechia and late iris prolapse, only one or two sutures should be used; they should pass no deeper than half the thickness of the cornea, should not be too tightly tied, and must be removed between the tenth and the twelfth day after operation.

Stallard is of the opinion that more nearly exact apposition is achieved by the so-called "preplaced" suture. He prefers a modification of MacLean's preplaced corneoscleral suture with a stay-knot on the cornea when one suture is used, final passage of the suture through the conjunctival flap being postponed until after the extraction of the lens.

The technique of arranging the suture in order to separate the edges of the corneoscleral wound and to facilitate the completion of the section with a cataract knife is described, as follows: after a small tongue-shaped conjunctival flap is turned down over the upper part of the cornea a scleral hook is engaged in the limbus and held forward and downward in the 12–6 o'clock meridian to help fix the eye and to exert slight traction on the anterior lip of the 2.5 mm. corneoscleral incision made at, and concentric with, the limbus at 12 o'clock through slightly more than half its thickness. The point of the needle bearing Kalt's No. 000000 black silk engages the sclera almost vertically 1 mm. behind the center of the posterior lip of the incision and, when 0.3 mm. deep, is turned to emerge in the bottom of the incision, having traversed half the thickness (and no more) of the limbus. The needle engages the anterior lip of the incision and is then turned forward to emerge on the surface of the cornea 1 mm. below the incision. The conjunctival flap is replaced.

When 4 mm. of silk has emerged, the needle is removed from this end of the suture (which is double-armed) and a knot is tied 1 cm. from the end of the suture; the suture is drawn out into a loop; the knot acts as a stay against which the suture may be drawn and the section is quickly and firmly closed immediately on delivery of the lens.

When the toilet is complete, the conjunctival flap is held in forceps and drawn upward to a plane at an angle of about 30 degrees with the sclera, sufficient to allow the passage of the needle on the scleral arm of the suture, from the deep surface of the conjunctiva to its superficial surface 1 mm. above the limbus in the meridian of the suture as it traverses the limbus. The free corneal arm of the suture with its knot is now drawn forward for 1 cm. so that the knot is clear of the cornea. The knot is then cut off the corneal arm of the suture and, with suture-tying forceps, a surgical knot is tied with sufficient firmness to coapt the edges of the section without tension. The edges of the conjunctival incision are closed with three to five interrupted sutures.

This procedure was performed in 331 consecutive cases without iris prolapse. The anterior chamber was absent for 7 days after the removal of one suture, but it reformed; peripheral synechia at 12 o'clock had occurred in one patient, and hyphemia of from 1 to 2 mm. occurred in eight patients.

Two corneoscleral sutures may be used if desired, placed at 11 o'clock and 1 o'clock, the first through the scleral lip of the 2 mm. long half-thickness limbal incision at 11 o'clock, then through the corneal lip, thence over the surface of the cornea to enter the corneal lip of the 1 o'clock half-thickness limbal incision, and afterwards through the scleral lip.

—Joshua Zuckerman, M.D.

Malignant Melanoma of the Iris and Ciliary Body of a One-Eyed Patient. Case Observed for 20 Years. IVAN J. KOENIG. *Arch. Ophth.*, Chic., 1954, 51: 656.

A MALIGNANT melanoma of the iris and ciliary body was observed by the author for 20 years and may have been present for an additional 30 years. The patient died as a result of a coronary occlusion in February, 1952, at the age of 77. The eye was examined histologically and the diagnosis verified. Autopsy failed to reveal evidence of metastasis.

J. Jack Stokes, M.D.

Posterior (Eccentric) Lenticonus. Report of First Case with Clinical and Histological Findings. A. FRANCESCHETTI and H. RICKLI. *Arch. Ophth., Chic.*, 1954, 51: 499.

THE authors present for the first time, the clinical and histological findings in a case of posterior (eccentric) lenticonus.

Approximately 90 cases of posterior lenticonus in man have been published previously. Becker (1883) first described posterior lenticonus anatomically in the rabbit; Meyer (1888) described it clinically.

In this case there was a peripheral posterior lenticonus in a boy 4 years of age. He presented a cystic brownish formation behind the lens on the temporal side of the right eye and on the periphery at 7 o'clock.

Slit lamp examination revealed a globular formation of the lens with a marked backward convexity. The characteristic ring reflex was present around the ectasia and the cross reflexes (scissors movement) on the surface. The posterior surface was covered by a dense, finely crackled layer of pigment without any vascularization. There was no trace of a persistent hyaloid artery. The zones of discontinuity and the two embryonic sutures were faintly visible and the embryonic nucleus was not displaced.

It is pointed out that lenticonus is almost always found on the posterior pole, or near it.

The lenticonus was considered a congenital anomaly because it was associated with a series of important anomalies, such as slight microcornea, posterior marginal dysplasia of the cornea, coloboma of the iris, and of the choroid. There was neither a rupture of the capsule nor a persistent hyaloid artery. The clinical findings were confirmed by histologic sections.

In one section, the lenticonus was linked on the temporal side to the ciliary body (which, moreover, was hypoplastic at this point) by a tissue formation, the various layers of which suggested a degenerated retina covered on its surfaces by a layer of pigment.

The association of peripheral posterior lenticoni with numerous congenital malformations in this case

suggests a prenatal origin of the crystalline ectasia. The epithelial layers covering the two lenticoni may have played a part in the genesis of the crystalline estasia. There was a zone of heterotropic nuclei at the level of the upper lenticonus as well as at that of the lower lenticonus.

The hypothesis of an exaggerated apposition of crystalline fibers in connection with an aberrant zone of growth is proposed as an etiologic factor.

—Joshua Zuckerman, M.D.

Oxygenation and Retrolental Fibroplasia. THEODORE H. INGALLS and NATESAIER PURSHOTTAM. *N. England J. M.*, 1954, 250: 621.

THE authors present an exhaustive review of the subject of oxygenation as an etiologic factor in the appearance of retrolental fibroplasia in premature infants. The article is accompanied by a bibliography of 65 references.

There can be no doubt that the administration of abnormally high concentrations of oxygen in modern incubators may initiate an abnormal development of the vascular system of the premature retina resulting in ultimate blindness. It is postulated that the hyperoxia induced causes structural changes through interference with enzyme systems, with resultant histotoxic anoxia of the retinal cells. In addition, other environmental factors such as temperature, humidity, electrolyte shifts, etc., probably influence the onset and the severity of the condition.

Clinical, experimental, and epidemiologic evidence show that the anomaly of the retinal vascular system has been prevented by careful attention to an optimal supply of oxygen.

Anyone interested in the complex problem of retrolental fibroplasia will find this article of much interest.

—J. Winston Duggan, M.D.

Effect of Area and Intensity on the Size and Shape of the Electroretinogram; Exclusion of Stray Light Effects. ALBERTO WIRTH and BIRGITTA ZETTERSTRÖM. *Brit. J. Ophth.*, 1954, 38: 257.

STUDIES were conducted to determine the minimal retinal area which, upon stimulation at high intensities, would produce a standard electroretinogram. The stimulated areas were varied in size. Stray light was excluded.

Small, sharply restricted areas do not give small electroretinograms of the high intensity type such as are recorded when the whole retina is stimulated. When areas of less than 3 to 5 mm. in diameter were stimulated, the response assumed the characteristics of low-intensity electroretinograms. Increase in the intensity of the stimulus will not compensate for this effect of area.

—J. Jack Stokes, M.D.

Aplasia of the Optic Nerve; Report of 3 Cases. HOMER E. SMITH. *Am. J. Ophth.*, 1954, 37: 498.

THREE cases of aplasia of the optic nerve are reported, and this increases the total number found in the literature to 10. This rare condition may be bilateral or unilateral. It is not uncommonly found in association with other ocular and central nervous system anomalies such as microphthalmos, cyclopia, orbital meningoencephalocele, and anencephaly.

Of the 3 cases reported, the condition was bilateral in 1 child, and unilateral in the remaining 2 children. The affected eyes all showed vision of only light perception. The anterior segments were normal except that the direct light reaction of the pupils was minimal. Two of the eyes showed a good consensual pupillary reaction. Fundus examination showed the disc to be one-third to one-half the size of the normal disc and vertically oval. The color was white and the margins were sharp. Accumulation of pigment at the disc margin was noted in 2 of the cases. Little or no nerve tissue was made out, the disc area being filled with glial tissue. In all cases the retinal vascular pattern appeared to be normal. No specific area of macular differentiation could be seen.

Optic nerve aplasia has been observed and studied histologically in cats and mice (Zeeman and Tumbelaka; Szymanski; Bien). These studies showed that in some eyes the papilla and central retinal vessels were totally absent. The retina, pigment epithelium, choroid, and sclera were uninterrupted in their continuity. The ganglion-cell and nerve fiber layer of the retina was absent and the optic nerves, chiasm, and tracts were missing. Another eye showed an optic disc with a large excavation. The temporal retina was normal, but the nasal retina showed absence of the nerve fiber and ganglion-cell layers.

The condition may accordingly be classified as true optic nerve aplasia (no optic disc and no central retinal vessels), or as hypoplasia of the optic nerve (small optic discs with nearly normal central retinal vessels). The etiology is not clear, but embryologically the following possible causative factors are suggested.

If, by the 10 mm. stage of embryologic development, the para-axial mesoderm has failed to grow through the upper part of the fetal fissure it is conceivable that the fissure would close completely. This would result in absence of the disc and central retinal vessels (true aplasia).

By the 17 mm. stage, the retinal ganglion cells have appeared and the dendrites originating from these cells contribute the neural elements of the papilla and optic nerve. A failure of retinal differentiation at this stage would cause an absence of these dendrites and the disc and optic nerve would contain little if any of the normal neural tissue. A normal vascular structure would be expected (hypoplasia of the optic nerve).

—Henry M. Dismukes, M.D.

EAR

Aspects of Hearing Physiopathology During the First Postoperative Period Following Fenestration. G. ZANOTTI. *Ann. Otol. Rhinol.*, 1954, 63: 69.

THE author describes the results of his tests on 30 ideal candidates for fenestration, operated upon by the Lempert "cupole" technique. His tests were done on the third, eighth, and thirtieth postoperative days. The author did not study the hearing prior to the third day, but remarks that hearing is known to improve during the first hours after surgery, although, for technical reasons, this period has never been adequately studied.

On the third day, the author studied all of his 30 cases, without removing the bandage or packing, and

found a depression of all frequencies, varying from 15 to 20 decibels in the lower and middle frequencies, to 40 and 50 decibels in the 2,000 and 4,000 cycle frequencies. In Weber tests the vibrations were referred to the ear operated upon in all cases, except those in the 4,000 frequency in 70 per cent of which the vibrations were referred to the opposite side. No recruitment was found, and bone study tests were said to be nearly identical to those obtained from testing the ear not operated on. It is not stated whether or not masking was used.

On the eighth postoperative day, after the dressing and all of the packing except two small pieces of gauze had been removed from the ear, the air conduction was noted to have improved to the preoperative level except for a 28, 40, and 50 decibel deficit in the 2,000, 4,000 and 8,000 frequencies.

Bone conduction tests showed diminished hearing, particularly in the high tones, in 40 per cent of the cases. Again, it is not known whether or not masking was used. The Weber test was unchanged, and recruitment and diplacusis were not found. Speech audiometry and discrimination tests were not remarkable or different from the ear not operated on.

The author does not enumerate or summarize his tests at the 30-day interval, but does mention that the air conduction reaches and passes the preoperative level at about 2 weeks, and at the end of the first month the bone conduction reaches a level which is apparently definite, and which is on an average of 20 decibels higher than the preoperative level, with the greatest gain in the middle frequencies. Presumably, by this time, all packs are out of the middle ear and there has been a sufficient time lapse for some swelling to subside, and for fluid to have been removed.

The author notes the work of Shambaugh, Lempert, Juers, and others, indicating that postoperative labyrinthine reaction responsible for impairment of high frequencies, particularly during the first 4 weeks, is due to aseptic serous labyrinthitis. He says that in his 30 cases, the impairment for high tones rapidly improves and can no longer be seen a month after surgery. He does not cite any actual statistics, however.

The author cites some of the work which has been done on the physiology of postoperative fenestration patients. He believes that the so-called postoperative aseptic labyrinthitis, which is set up following the trauma associated with performing a fenestration, involves only the posterior labyrinth, and never the anterior labyrinth. He believes that the postoperative high tone impairment, which lasts from the third to the twentieth day, is not based upon damage to the cochlea, but rather upon mechanical factors which may be identified with an increase in the mass of the new vibrating system, owing to the reactive edema of the tympanomeatal flap, and which can be explained by the impedance formula. This concept, while somewhat on a theoretical basis, is certainly worthy of consideration.

—William K. Wright, M.D.

Repair of Tympanic Membrane Perforations with Human Amniotic Membrane. Report of 53 Cases. WILLIAM J. SCHRIMPF. *Ann. Otol. Rhinol.*, 1954, 63: 101.

THE author reviews the accumulation of knowledge regarding the middle ear and ear drum, as well as the historical methods of compensating for, or repairing, tympanic membrane perforations with the use of a patching technique, and by the application of trichloracetic acid and other caustics to the free margins of the perforation.

This is a very comprehensive survey, except for the omission of the work by Derlacki who has had a very extensive experience in the use of the Linn treatment. The author also summarizes his own experience in the evolution of his present method of closing perforations. His reason for finally choosing amniotic membrane in preference to all other methods was that it was transparent, so that closure of the perforation could be followed through the transparent patch, and also because of its extreme adhesive qualities.

The author describes his method for obtaining, sterilizing, drying, and preparing the amniotic membrane. He emphasizes the necessity for remembering which side the chorion was adherent to, since this is the mesodermal surface which has extreme adhesive qualities and should be applied to the tympanic membrane. In applying the amniotic membrane to the perforation, the ear canal is first cleansed of the cerumen and desquamated epithelium. The drum is then anesthetized with Grey's solution for 10 minutes, after which the free margin of the perforation is cauterized with 50 per cent trichloracetic acid for an area about ½ mm. around the margin of the perforation. A disc of the amniotic membrane, of appropriate size, is then picked up and placed over the perforation under sterile precautions. As soon as the amniotic membrane is in place it becomes transparent and it is possible to follow the gradual progress of closure.

The author reports 48 successful closures among 53 cases. These closures were in central perforations where there is at least a rim of drum remaining. The length of time necessary to effect a closure varies from 7 to 210 days, with an average of 43 days. The smaller perforations heal with almost a normal appearing drum, whereas the larger ones have a more transparent, thinner healing zone. It is also generally noted that the larger the perforation, the greater the hearing loss, the longer the healing time, and the thinner the zone of healing. On examining the 5 unsuccessful cases, it was noted that failure in 3 was directly due to repeated infections; in the other 2 cases failure could not be explained. A composite audiogram showed a gain from a flat 30 decibel loss to a flat 10 decibel loss for all frequencies.

This is a very interesting series of cases and, while it is not large, a higher percentage of success was obtained than has yet been reported. The method, as such, is not greatly different from methods which have been employed previously, and could be easily adopted by anyone doing this type of work.

—William K. Wright, M.D.

NOSE AND SINUSES

Lethal Granuloma of the Nose and Face. FRED W. ALEXANDER. *Ann. Otol. Rhinol.*, 1954, 63: 171.

THE author presents 2 cases of midline lethal granuloma of the nose and face. These are typical examples of this disease in that there was a gradual progression of the granuloma which did not respond at all to any

antibiotic, and in which the host showed very little resistance to the disease. No evidence of any specific granuloma such as tuberculosis, syphilis, brucellosis, allergies, or any other of the mycotic diseases was found in either case.

In addition to the usual unavailing antibiotics and drainage, one of the patients was treated with ACTH and, later, cortisone. Apparently, this treatment made the patient feel better, reduced the temperature, and diminished the signs of general infection, but did not materially affect the course or outcome of the disease, although the patient did live several months longer than the one who was not treated with hormones.

The author cites a personal communication from Paul Moore who likewise treated a patient with this disease with ACTH. This patient had a remission, but has since died of the disease. The author believes that while there has been a preliminary hope for cure of this disease with the use of ACTH and cortisone, there may be some reason to believe that these good preliminary reports will not be lasting.

—William K. Wright, M.D.

MOUTH

Velopharyngeal Closure; an Index of Speech. Robert Hagerty and F. S. Hoffmeister. *Plastic & Reconstr. Surg.*, 1954, 13: 290.

The cleft palate is closed to improve speech. Therefore, a measure of the resulting speech is the index of success in palatal closure. Previously only a subjective index was made which is variable even with trained competent personnel.

Many different types of palatal closure are being performed, and to compare the results, it is necessary to have an objective quantitative evaluation of speech.

In an attempt to make such a quantitative evaluation of speech, the following technique was designed to study and measure the functional competence of the velopharyngeal closure. One cubic centimeter of lipiodol is introduced into each nostril of the supine patient. In about 30 seconds the patient sits up and lateral roentgenograms are taken at a fixed distance from the midline of the head, with the palate relaxed, the "AH" sound position, and the "hissing" sound position. In each roentgenogram the minimal distance from the posterior aspect of the soft palate to the posterior pharyngeal wall is measured and labeled the minimal velopharyngeal distance.

Forty-four patients who were operated upon by the Warren Davis technique were studied.

It was found that the minimal velopharyngeal distance is most strongly related to the degree of nasality and articulatory distortion when the "ss" sound is produced. About 75 per cent of the cases can be correctly classified by the minimal velopharyngeal measurement.

—John R. Lindsay, M.D.

NECK

Laryngeal Palsy. G. M. Ardran, F. H. Kemp, and P. M. Marland. *Brit. J. Radiol.*, 1954, 27: 201.

An account of the roentgenographic studies of the mode of closure of the larynx in normal individuals had been presented by these authors in a previous paper. The present investigation was to determine whether observations on patients suffering from laryngeal palsy were in agreement with their previous conclusions.

Fifteen patients were examined by roentgenography, tomography, and cineradiography. Films were taken during quiet breathing, on saying "ee," on bearing down, and on swallowing barium suspension.

In unilateral laryngeal palsy, during quiet breathing, the vocal fold on the unaffected side is turned upwards as in normal individuals, while on the affected side it projected across the lumen. In those with bilateral laryngeal palsy, the vocal fold on both sides projects across the airway. A discussion is given, and photographs shown, of the position of the vocal cords during vocalization in both unilateral and bilateral palsy.

The authors conclude that the mode of behavior of the palsied larynx agrees with that found in the normal larynx.

—Ely Elliott Lazarus, M.D.

Cancer of the Larynx; Laryngoplasty to Avoid Laryngectomy. Joel J. Pressman. *Arch. Otolar.*, Chic., 1954, 59: 395.

The surgical principles presented by the author have made it possible to remove almost the entire larynx and yet retain a normal airway. Three technical problems exist: (1) the need to create a lining (this lining is supplied by the external perichondrium of both alae of the thyroid cartilage, which is preserved and retained in toto); (2) the need to provide a lumen (accomplished by use of a temporarily retained obturator); and (3) to lend rigidity (provided by the transplantation of the removed thyroid alae to a new site, or the substitution in a new position of thyroid alae from a cartilage bank).

The name "laryngoplasty" has been given to designate this procedure.

A tracheotomy is first performed through a low transverse incision. The skin incision can be either transverse or vertical to expose the thyroid cartilage. The sternohyoid muscles are retracted laterally and, by blunt finger dissection, a pocket between them and the deeper ribbon muscles is created on each side.

Incisions are made through the perichondrium of the thyroid cartilage, the first one vertical along the angle, with extensions from it laterally along the upper and lower borders. As the perichondrium is dissected off the thyroid cartilage, its margins are sutured to the deeper layers of ribbon muscles. The thyroid cartilage is then split in the midline and the inner perichondrial layer is separated from the thyroid cartilage. When the cornu is exposed, the cartilage is removed and saved for later use. The inferior cornu may be disarticulated and left in situ.

A transverse incision is made above in the thyrohyoid membrane and carried laterally and backward on the side of lesser involvement, almost to the posterior limit of the larynx. From this point it is carried downward just anterior to the arytenoid cartilage. It is then continued forward just above the cricoid cartilage, severing the cricothyroid membrane. The disease-bearing area is then exposed and the incision is carried backward above the cricoid cartilage, encircling the larynx to the middle of the arytenoid, and

then curved upward to the original incision, thus permitting removal of the specimen including the arytenoid on the more involved side.

In closure, the severed edge of the mucosal lining is approximated to the posterior and inferior margins of the external layer of perichondrium. In the pocket made early between the deeper and superficial ribbon muscles, the alae of the thyroid cartilage are placed on each side and sutured through-and-through to the perichondral muscle sheet.

An obturator is placed within the lumen and transfixed in such a manner that the upper margin is higher than the laryngeal inlet with the sutures taut.

The epiglottis and adjacent soft tissues are everted and sutured to the hyoid bone.

The two sides of the new larynx are then approximated, and the superficial structures and skin are united. Drainage tubes are inserted independently on each side. By direct laryngoscopy, and with a pair of heavy curved scissors, that part of the hollow obturator which protrudes above the level of the aryepiglottic fold is removed. The obturator is left in place for at least 6 weeks, and when a safe airway has been established the tracheotomy is closed.

This operation is indicated (1) when the tumor has extended too far posteriorly to permit simple laryngofissure, or too far on the contralateral cord to permit the anterior commissure laryngofissure; (2) when the extension of a limited lesion is above or below the cord for a reasonable distance.

With this operation, effort is directed toward permitting the patient to breathe through the normal airway and to speak with a natural, if not normal, voice. —*John R. Lindsay, M.D.*

A Modified Approach for the Surgical Correction of Bilateral Abductor Vocal Cord Paralysis. ARNOLD A. GROSSMAN. *Canad. M. Ass. J.*, 1954, 70: 521.

THE author has encountered only one patient who required treatment for relief of bilateral abductor cord paralysis. He used the Kelly, King, Orton, and Woodman techniques on several cadavers and found that all of these techniques left much to be desired. Ultimately, a procedure was developed which is a modification of the usual surgical approach to the cricoarytenoid joint.

With the fixed points of the omohyoid and sternomastoid muscles as landmarks, an open anterior approach is used. The cricothyroid joint is not disarticulated, as this procedure was found to be difficult even in the cadaver. To mobilize the thyroid cartilage, an incision is made through the inferior and superior horns at their attachment to the thyroid lamina. Cutting through the base of the superior horn alone did not allow adequate access to the deeper structures. The incision in the inferior horn is well above the region of the cricothyroid joint, and is therefore more easily accomplished than the disarticulation of the cricothyroid joint. The thyroid cartilage is routinely perforated at the true cord level to facilitate proper lateralization and fixation of the true cord. The entire thyroid cartilage must be left behind as a bulwark against indrawing of the neck tissues into the larynx. Accurate fixation after lateralization of the vocal cord, or of both the true cord and the arytenoid cartilage, is best obtained by the employment of direct laryngoscopic vision while the lateralization process is taking place.

He emphasizes the point that patients who refuse to wear a tracheotomy tube when both vocal cords are fixed in the paramedian position are endangering their lives. The chance of sudden unexpected exertion by the patient, or fulminating laryngitis causing a fatal anoxia is real.

Cord lateralization should not be attempted for at least 6 months, and preferably not before 18 months following bilateral midline cord fixation resulting from thyroidectomy, because a large number of paralyzed cords may spontaneously return to normal function. —*Matthew H. Evoy, M.D.*

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Arteriovenous Aneurysms of the Ampulla of Galen in Infants; Their Part in Noncommunicating Hydrocephalus. (Anévrysmes artério-veineux de l'ampoule de Galien chez le nourrisson; leur role dans l'hydrocéphalie non communicante). ROBERT CLEMENT, J. GERBEAUX, A. COMBES-HAMELLE, B. PERTUISET, and C. PETRANCA. *Presse méd.*, 1954, 62: 658.

AMONG the vascular intracranial malformations aneurysm of the ampulla of Galen has definite clinical, anatomical and embryological characteristics. Its congenital nature in young infants and its location in the center of the brain produce signs of compression of the brain stem, midbrain, and aqueduct of Sylvius, resulting in noncommunicating hydrocephalus and associated with subarachnoid hemorrhage and sudden death. The aneurysm is usually a spherical dilatation of the end of the great cerebral vein of Galen associated with a network of arterioles which communicates with the arterial system. These malformations are apparently hard to diagnose as only 9 cases have been reported in the literature and most of them were discovered only at autopsy. Surgical treatment requires that an early diagnosis be made as death is usually sudden and unexpected.

The authors report 2 cases, both in females. The first patient was cyanotic and had periods of apnea immediately after birth. Cyanosis and dyspnea improved on the third day following a lumbar puncture which revealed xanthochromic fluid, but 10 days later these conditions recurred. The patient then presented new symptoms such as hypotonia, difficulty in swallowing, and respiratory disturbances. The respiration was irregular, interrupted by periods of apnea, producing cyanosis. It was thought that the patient had bulbar compression; however, ventriculography gave normal findings. At the age of 1 month the child had to be put in an oxygen tent, the dyspnea became constant, and tachycardia as well as peripheral edema developed. Death occurred at the age of 5 weeks. Autopsy revealed an ovoid aneurysmal dilatation at the junction of the free edge of the falx with the tentorium cerebelli. Attached to the vein of Galen, there was a dilatation of the vein draining into the great cerebral vein and there were direct communications with branches of the posterior cerebral arteries. This aneurysm compressed the cerebellum and was filled with a large thrombus.

The second child was also cyanotic at the time of birth but was otherwise asymptomatic until the age of 3 months when she started to vomit, and became dehydrated, hypertonic, and dyspneic. The anterior fontanel was tense and the ventricular fluid was under pressure, but clear. At the age of 4 months the circumference of her head was 43 cm., the epicranial veins were prominent, and there was a loud systolic bruit over the entire skull. Cerebral angiography revealed a tremendous dilatation of the right sinus rectus, torcular Herophili, and lateral sinus, as well as an arteriovenous aneurysm of the ampulla of Galen. Surgical treatment was considered but was delayed because of febrile episodes and diarrhea. At the age of 8 months the child died suddenly. Autopsy revealed an ovoid aneurysm measuring 3 by 1.5 cm. situated between the tela choroidea and the mesocephalon. The sinus rectus and torcular Herophili were greatly dilated. A network of small vessels arising from both posterior cerebral arteries communicated with the aneurysm. This aneurysm to the ampulla of Galen drained posteriorly into the sinus rectus. Other anomalies were present. The two anterior cerebral arteries supplied only the left cerebral hemisphere while a large portion of the right cerebral hemisphere was supplied by a very large right posterior cerebral artery.

These aneurysmal sacs had the structure of veins and may correspond to the ones described by Virchow in 1867, by Cushing and Bailey in 1928, and Bergstrang and Olivecrona in 1936 as racemose angioma. —*George Perret, M.D.*

SPINAL CORD AND ITS COVERINGS

Indirect Spinal Cord Injuries Due to Gunshot Wounds of the Spinal Column in Animal and Man. WOLFGANG W. KLEMPERER, JOHN F. FULTON, HAROLD KAMPORT, and MARVIN G. SCHORR. *Mil. Surgeon*, 1954, 114: 253.

IT was learned from war experience that a bullet which merely tears off the tip of a posterior spinous process can cause as severe injury to the spinal cord as if it had penetrated into the spinal cord itself. Such observations stimulated the authors to attempt to produce, experimentally, indirect spinal cord injuries in animals, and then to seek an explanation of its mechanism as an aid in the treatment of spinal cord injury in man. The experiments were carried out on cats, dogs, monkeys, and on one sheep. Direct gunshot injuries involving the spinous process in the animals at the first lumbar level were obtained. An electrically-fired special gun was used, with an estimated speed of 3,300 feet per second for the missile.

Four hours after injury motor, sensory, and reflex examinations of the animal were made and under renewed ether anesthesia, one of three forms of therapy was given: (a) débridement of the damaged tissue with removal of loose bone fragments followed by skin closures, (b) laminectomy extending over three laminae centering on the first lumbar vertebra without dural opening, or (c) laminectomy of the same extent with dural opening.

Subsequently, gross and histological studies of the experimental lesion were carried out at intervals ranging from 3 hours to 44 days after the initial trauma. Failure to produce noticeable neurological changes in the first 6 dogs prompted the use of a heavier missile with greater energy of impact, traveling at about the same speed. This again did not evoke any abnormal clinical signs.

In cats, the results were quite different. Seventeen out of 20 cats demonstrated evidence of complete physiological spinal cord lesions and 3 showed signs of incomplete lesions. The reaction of the monkey was more like that of the cat's, while the sheep failed to exhibit any sign of spinal cord injury. An accurate evaluation of any permanent damage to the spinal cord is not possible during the early post-traumatic period. The transitory state which follows is reported to be associated with demonstrable histological changes which may last from fractions of a second to several months, even up to 1 year. In other words, for an indefinite period both reparable and irreparable damage coexist. It is furthermore known that the reparable damage can again be subdivided into two types, the first representing that type of trauma from which the spinal cord can recover by itself, the second that which can be remedied only by beneficial débridement, decompression, or repair of the spinal cord or its surrounding structures. All efforts directed at accurate differentiation of recoverable repairable trauma from lasting trauma have so far failed.

Skin resistance measurements were carried out in an effort to make some quantitative determination of spinal cord trauma but gave no satisfactory information.

Details of the pathological changes found in the spinal cord following these traumatic experiments are recorded.

In comparing the experimental studies with those reported injuries during World War II, the authors conclude that the mechanism of indirect spinal cord injuries due to missiles can as yet be based only upon suppositions; however, all evidence seems to point to the fact that forces required to produce this type of injury had to be those of high-velocity missiles. Flexibility of the spinal column seems to be necessary for such injury to occur, and in dogs and sheep, with stable spinal columns, the injury could not be reproduced. The therapeutic measures undertaken in the experimental animals included laminectomy on 23 cats and the authors concluded that none of these procedures was followed by any startling recovery.

—*Howard A. Brown, M.D.*

Clinical Contributions to Problems of Ischialgia

(Klinische Beitraege zum Fragenkreis der Ischialgie). H. B. Sprung. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1954, 278: 7.

Ischialgia, first described by Cotugno in 1746, has many causes which may relate to various fields and consequently may require the services of the internist, surgeon, gynecologist, dermatologist, urologist, neurologist, orthopedist, and even the dentist. Anatomically, one distinguishes the spinal roots and spinal nerves (L-4 - - S-3) which form the sciatic plexus and sciatic nerves. Accordingly one differentiates plexus or peripheral neuritis and radiculopathies.

In peripheral lesions pain is the characteristic symptom; however, motor signs (paresis of the intrinsic muscles of the foot and atrophy) and autonomic signs (cyanotic, clammy, or glossy skin, and Sudeck's neurotrophic osseous dystrophy) are also present. There is no pain on coughing, sneezing, or increasing the intra-abdominal pressure, and low back pain, lumbar rigidity, tenderness of the spinous processes, and scoliosis are absent. Etiologically, the causes are intoxication (alcohol, lead, arsenic, bismuth, carbon monoxide), infection, and allergic, metabolic (diabetes, gout), and avitaminotic conditions. Vascular peripheral ischialgia is characterized by intermittent claudication. Surgical causes of peripheral ischialgia are rare (sciatic hernia, exostosis of the tibia, and tumors of the pelvis).

Manifestations of radiculopathy depend on the involvement of the respective anatomical structure, root, or spinal nerve. The dorsal ramus of the nerve mediates pain and muscle spasm, which leads to scoliosis. Impulses caused by spinal fluid pressure changes course through the meningeal ramus. Disturbances in motor and reflex activity of the extremity result from involvement of the ventral ramus. The autonomic supply for the sciatic nerve drives from higher segments (T-10 to L-2); therefore, there is a paucity of autonomic manifestations in radiculopathies of the nerves from L-4 to S-3. There may be a monoradiculitis or a polyradiculitis. The diagnosis of a radiculitis of the nerves from L-5 to S-1 is facilitated by using the chart of Keegan and Norlen. Discogenic disease was found to be the cause in 61 (20%) of 300 cases of radiculopathy. In 211 of the cases the etiology could be determined, while it remained unknown in 89 cases. In addition to the 61 patients with discogenic disease, 49 with radiculitis, 45 with arachnitis, and 11 with endangitis obliterans of the cord are the subject of this report; in all of them there are signs similar to sciatica, differential diagnosis is possible, and no roentgenological signs are lacking.

In discogenic radiculopathy the terms "discogenic disease" or "degeneration" are preferred to the term "prolapse." Thirty-six of the 61 patients responded to conservative therapy; in 15 of 25 patients a prolapse was seen; in 7 patients there was a narrowing of the intervertebral foramen; in 2 patients varicosities were encountered instead of the expected disc, and in 1 patient no changes were found. The average age of the patients was 35 years for those with discs, and 49 years for those with narrowing of the intervertebral foramen. The signs are twofold: neurological signs of irritation and the splinting position. In monoradiculitis usually the fifth lumbar or first sacral, rarely the fourth lumbar, nerves are involved; however, some monoradiculitides start with signs of polyradiculitis, irritative phenomena occur by spread, and the sacral dermatomes are more frequently involved than the lumbar. Spread through irritation of the meningeal ramus is observed. Epidural sacral injection may reduce the manifestations of spread. Muscle splinting, spasm, and guarding are caused by involvement of the dorsal ramus; pain in the sacroiliac joint is caused by the first sacral nerve, not the fifth lumbar nerve. Increase in pain with increased abdominal pressure leads to an increase of the spinal fluid pressure. The pathological posture (scoliosis) tends to relieve pressure by enlarging the intervertebral space and is a guarding reflex (afferent—meningeal ramus; efferent—dorsal ramus). A clinical diagnosis is usually possible. Roentgenological signs are a dorsal shift of the vertebra above the lesion,

disappearance of the physiologic lordosis, and narrowing of the intervertebral space.

In radiculopathy from radiculitis there is usually polyradiculitis consequent to intoxication, a rheumatic condition, or chronic and focal infection. Forty-nine cases of this type of radiculopathy were observed. The signs are milder than those of discogenic disease. Concurrent dissemination involving the cervical and thoracic segments is occasionally seen.

Radiculopathy from arachnitis includes meningitis serosa circumscripta, fibrous arachnitis, cystic arachnitis, adhesive arachnitis, and the severe meningoradiculopathies. These conditions may have the same cause. Forty-five patients were observed; 30 were treated conservatively and 15 by operation. Improvement from early decompression was observed. The manifestations are polyradicular; postural changes are absent and cord involvement may cause hyper-reflexia and sphincteric disturbances. Autonomic, trophic changes of the lower extremities are frequent. Due to alternating spinal fluid stasis, the symptoms and signs also fluctuate. Nocturnal pain is caused by circumscribed increase of the spinal fluid pressure, which disappears with walking during the day. A cauda tumor shows a similar picture although it is usually accompanied by hyperesthesia above the lesion, which is not present with arachnitis.

Radiculopathy from vasopathy is caused either by varicosities or endangitis obliterans of the cord. Varices of the lumbar root veins are rare. A monoradicular syndrome may simulate discogenic disease. Elevation of the legs and lower part of the body may decrease the complaints, and this of itself is suggestive for the diagnosis. Exploration with ligation of a single varix confirms the diagnosis. A diffuse phlebectasia causes a polyradicular syndrome and cannot be treated surgically. Spinal endangitis obliterans leads to intermittent dysbasia accompanied by a segmental neurological deficit which concerns the posterior horn and usually remains confined to the roots below L-3 and L-4 because of the lack of root arteries below that level. In all 11 of the author's cases the neurologic changes occurred below L-4.

—*Ernest Bors, M.D.*

SYMPATHETIC NERVES

Some Unsolved Problems in the Surgery of the Sympathetic Nervous System. JAMES PATERSON ROSS. *Q. Bull. Northwest. Univ. M. School*, 1954, 28: 1.

THE author discusses some of the unsolved problems of the physiology and the surgery of the sympathetic nervous system. He tries to explain some of the apparent contradictions created by the results of operation upon the sympathetic nervous system. The evaluation of results should include careful differentiation between persistence or restoration of sympathetic innervation and persistence of disorder of function. He believes that improvement in blood supply to an extremity can be measured by plethysmography. The decrease of blood flow occurring a few days after operation and after immediate postoperative increase in blood flow may be the result of a change in the arterial walls while the increase in skin temperature which is often permanent may result from the denervation of the glomera which would then act as arteriovenous fistulas. Should the return of sympathetic innervation occur after sympathectomy, one may assume that nerve impulses must be traveling along accessory pathways rather than over regenerated fibers.

The author seems to agree with Barcroft in believing that denervated structures become more sensitive to the chemical substances which normally mediate nerve impulses to them. This humoral mechanism may explain the poor results of sympathectomy seen in Raynaud's disease, and also the uniform success in cases of hyperhidrosis, the sympathetic nerves to the sweat glands containing the only postganglionic fibers which are cholinergic. He does not believe that spasms play an important role in the cause of ischemia and attributes intermittent claudication to the accumulation of pain-producing chemical substance in active muscle. Even when there is clinical evidence of arterial disease, a rise in skin temperature following sympathetic paralysis does not indicate that the disease has an associated element of spasm, but merely means that the arteries, though diseased, are still capable of responding to some extent as normal arteries do, by dilating when the vasoconstrictor nerves are paralyzed. Thus, sympathectomy is indicated in vascular disease, either to encourage the opening up of a collateral circulation, or for its peculiar effect upon arterioles and capillaries. Sympathectomy is of value in the alleviation of certain unusual forms of pain, and can be relied upon to cure excessive sweating.

Even though the blood flow through collateral vessels diminishes considerably within a few days after sympathectomy, it nevertheless is increased above the preoperative level and the final results are usually sufficient to justify the operation, especially when there is a complete block of the main vessel which has to be by-passed. Of course, little improvement can be expected if there is extensive atheromatous degeneration of the main vessels proximal to the block, or if the collateral vessels themselves are arteriosclerotic. In such cases, some clinical signs may indicate that the cases are unlikely to benefit from operation: wasting of the painful muscles and widespread arterial degeneration. In order to promote collateral circulation in the case of an iliac artery block, the first lumbar ganglion should be resected with the rest of the lumbar sympathetic chain in order to produce a dilatation of the collateral vessels in the hip region; however, there is evidence which suggests that the high operation can rob the distal tissues of blood by opening up the vascular bed in the proximal part of the limb and thus total sympathectomy of the lower extremity may be actually detrimental if the block is a peripheral one. The author seems to agree with Learmonth in warning against immediate sympathectomy for incipient gangrene of the toes, especially when edema of the foot is present, as the edema usually increases and establishes gangrene more definitely.

While the tone of arteries and veins depends upon vasomotor nerve impulses, the tone of the capillaries and venules is chiefly under chemical control being determined by the local concentration of vasodilator

or vasoconstrictor substances. The state of these minute vessels influences the color of the skin. However, the tone of these minute vessels increases to an increase in blood flow through them and gives rise to paler skin in the denervated area as a late result characterizing sympathectomy. The circulation in the minute vessel is likely to be restored to normal by sympathectomy when the seat of the disorder is in the arterioles, whereas if the trouble is in the arteries, the outcome is much less predictable. This may be the reason for the relatively poor results in the cases of Raynaud's disease.

The author discusses the problem of pain and erythralgia which are commonly associated with inflammation of the skin, chilblains, frostbite, herpes zoster, and causalgia. It may be possible that some of the pain is produced by stretching of minute vessels which may be sensitive to overdistention. Causalgia, being always associated with vasomotor disorders which are predominantly vasodilatation of the minute vessels in the hyperalgesic area, responds to sympathectomy with relief of pain, which always seems to be accompanied by the disappearance of the abnormal vasodilatation. The author concludes that pain and erythralgia will respond favorably to sympathetic denervation but that pain which is not accompanied by erythralgia cannot be expected to benefit from sympathectomy.

Gustatory sweating is an exaggeration of the flushing of the face and slight sweating which occurs in some individuals as they eat spicy or acid foods. It sometimes follows infections of the parotid gland and is not infrequently seen as a sequel to cervicothoracic sympathectomy. The most effective treatment for primary gustatory sweating or for the auriculotemporal syndrome is sympathectomy.

—George Perret, M.D.

MISCELLANEOUS

Protruded Lumbar Intervertebral Discs in Children. J. Hugh Webb, Hendrick J. Svien, and Roger L. J. Kennedy. *J. Am. M. Ass.*, 1954, 154: 1153.

Protruded intervertebral discs in the younger age group are rare; only 5, or .077 per cent, were encountered in a group of 6,500 patients under 16 years of age, who were operated upon for a protruded lumbar intervertebral disc.

Five cases are presented in some detail, and the authors comment that the clinical and pathological features do not differ significantly from those in adults who have similar lesions. A history of trauma was obtained in 3 of the 5 cases reported, and in one of the 5 patients a protrusion was demonstrated at both the fourth and fifth lumbar levels.

The clinical results were good and it is suggested that low backache and sciatica in a child should arouse suspicion of a possible intervertebral disc protrusion, if other causes can be excluded.

—Howard A. Brown, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

The Significance of Nipple Discharge. J. FREIDIN. *Austral. N. Zealand J. Surg.*, 1954, 23: 214.

THIRTY-TWO cases of nipple discharge were reviewed. The ages of the patients ranged from 26 to 67 years. Nine of the patients had a duct papilloma, 15 had microscopic evidence of hyperplasia of the duct epithelium, 7 had lobular hyperplasia, and 1 patient showed no demonstrable change in the resected tissue. It was interesting to note that in every one of the 32 cases of nipple discharge, pressure on a particular sector of the breast just near the areola reproduced the discharge, except that in a few cases fresh blood could be expressed; however, blood had not been discharged spontaneously.

It was found that there is a correlation between a lump found in the breast and a nipple discharge. If a discrete lump is found the chances of finding a microscopic papilloma and a preoperative diagnosis of duct papilloma are likely. The relationship of the type of discharge to the occurrence of the microscopic papilloma is of no significance. A duct papilloma may be found in cases in which no discrete lump is palpable. If the duration of the nipple discharge was longer than 9 months a duct papilloma or well formed multiple papillary projections were found in the author's cases.

It is pointed out that the lesions based on available evidence are considered benign. It is, therefore, urged that when an operation is performed, it should be the least mutilating procedure. Since the duct papillomas are difficult to visualize at operation, a sector incision is advised. The use of simple mastectomy is deprecated. —*John E. Karabin, M.D.*

Newer Methods of Managing Serious Injuries to the Chest. ELMER R. MAURER. *Am. J. Surg.*, 1954, 87: 462.

THE author discusses newer methods of managing serious chest injuries.

Patients with minor crushing injuries may be treated by simple adhesive strapping of the chest wall. If pain persists, intercostal nerve block with novocain should be done to obviate the development of the traumatic wet lung complex. The head of the bed should be elevated, and a program of assisted coughing should be carried out. If secretions are thick, expectorants may be used. Demerol or dromoron may be used in minimal doses, but morphine and barbiturates are contraindicated.

Atelectasis should be combated by bronchoscopic aspiration, with the patient upright in bed. If the patient's condition is too precarious, tracheobronchial aspiration with a nasal catheter may be done. In patients with absence of cough reflex due to an associated traumatic lesion in the brain, tracheotomy should be done. A clue to atelectasis is the occurrence of profuse diaphoresis. Penicillin therapy for at least 5 to 7 days is indicated.

Instability of the thoracic parietes resulting from segmental rib fractures or tearing loose of the sternum may produce paradoxic motion with serious ventilatory insufficiency, anoxia, and sudden death. Coughing is mechanically impossible, bronchial secretions are retained, pain is severe, and the traumatic wet lung complex rapidly ensues. Flail sternum may be treated by the application of a traction tong. Lateral chest wall instability requires positive pressure oxygen and a tracheotomy as soon as feasible.

Myocardial bruising may occur in seemingly minor chest injuries. Compression of the thorax may give rise to a wide variety of cardiac disturbances ranging from transient benign arrhythmias to ventricular fibrillation, heart block, and sudden death. Classically, these are "steering wheel" injuries. Electrocardiographic examination on admission is advisable in anterior chest wall injuries. Cardiac contusions should be treated by bed rest and additional oxygen.

Mediastinal emphysema commonly develops in sudden overdistention of the lungs, the primary source of air probably being a ruptured pulmonary alveolus. This air may produce a pneumothorax, mediastinal emphysema or subcutaneous emphysema. In most instances, mediastinal emphysema subsides spontaneously with bed rest, but if pressure increases, the air must be released by suprasternal notch incision and finger dissection into the superior anterior mediastinum. Lateral roentgenograms of the chest are diagnostic.

Pulmonary edema is difficult to manage, but new knowledge indicates that even large quantities of fluid can be tolerated in the respiratory passages as long as no foam is formed. The anti-foaming agent, octanol, administered by nebulization through a closed system utilizing a B.L.B. mask, with interposed humidifier bottle, has been very successful in clearing this condition.

Rupture of the lung may heal spontaneously, but may require bronchoscopic or catheter aspiration of the tracheobronchial tree, or even tracheotomy. Intravenous pituitrin reduces pulmonary vascular pressure in these cases. Subcutaneous emphysema may require multiple incisions in the skin of the chest wall or aspiration of the air with syringes and needle.

Indications for immediate open thoracotomy are: (1) uncontrollable bleeding from major vessels, (2) cardiac tamponade, (3) thoracoabdominal wounds, and (4) traumatic rupture of the bronchus. The latter lesion is rare and difficult to recognize. Shock is profound. Spontaneous recovery, if it occurs, usually results in bronchial stricture. Mechanism is a severe shearing force, and tears are commonest in main stem bronchi. Emergency treatment includes oxygen, blood, and parenteral fluids, closed tube thoracostomy, suprasternal notch incision, and careful bronchoscopy. If the patient's general condition permits, open thoracotomy with repair of the bronchus, or, if necessary, pneumonectomy or lobectomy should be done. Late bronchial strictures require bronchoscopic dilatation or surgical excision of the lung distal to the stricture.

Traumatic pneumothorax is treated by immediate closed tube thoracostomy. Hemothorax requires early evacuation by thoracentesis before clotting occurs to obviate later surgical decortication or enzymatic débridement of pleural surfaces. Even in minor compression injuries of the chest, routine roentgenograms 3 to 5 days after injury often show an effusion on the injured side.

Traumatic asphyxia is probably due to a sudden occlusion of the superior vena cava, with discoloration from venous stasis. If the patient survives the initial shock, recovery after the first few days occurs rapidly.

In patients with multiple injuries, a painful chest must not be ignored because of seemingly minor injury. Maintenance of an adequate airway, caution regarding anesthesia, and careful attention to the pulmonary apparatus are essential.

—*S. Lloyd Teitelman, M.D.*

TRACHEA, LUNGS, AND PLEURA

Tracheoesophageal Fistulas Due to Carcinoma of the Esophagus (Le fistole esofago-tracheali da carcinoma dell'esofago). M. MINI and F. MARSALA. *Ann. ital. chir.*, 1954, 30: 1037.

THE authors present 4 cases of tracheoesophageal fistulas due to carcinoma of the esophagus. These patients were seen during the period from 1938 to 1951 in the Surgical Clinic of the University of Bologna, where within the same period there were over 26,302 admissions, 1,698 patients operated on for cancer of various organs, 870 patients with cancer of the gastrointestinal tract, and 25 patients with carcinoma of the esophagus.

In the authors' 4 cases, gastrostomies only were done because of the poor general condition of the patients. It is believed that cough is an important physical symptom and that in the cases of patients in good condition, consideration should be given to various types of grafts to replace the affected segment of trachea. Up to the present time, fascia, glass, metal, or polythene has been used in isolated instances, but the most successful types of grafts have been skin grafts that have been reinforced by wire or metal.

—*Alexander J. Conte, M.D.*

Surgery for Pulmonary Tuberculosis: A Review of 100 Consecutive Cases. A. W. SUTHERLAND. *N. Zealand M. J.*, 1954, 53: 19.

DURING the period between 1950 and 1953, 170 operations were performed on 100 patients with pulmonary tuberculosis, at Timaru and Dunedin, New Zealand.

Thoracoplasties were performed on 54 patients without mortality. A single extrapleural pneumothorax was induced. Of 45 patients who underwent partial lung resections, 4 died from surgery, and 3 died later (2 of these from cerebral and myocardial disease and 1 from the spread of tuberculosis). Of 93 survivors, 89 gained negative sputum following the initial surgery, and 2 others after subsequent operations.

Indications, techniques, and complications are described.

—*Leonard D. Rosenman, M.D.*

A Comparison of Thoracoplasty and Resection Therapy in Pulmonary Tuberculosis. THOMAS G. BAFFES, PHYLLIS SCHLOTTERBECK, and PAUL T. DECAMP. *J. Thorac. Surg.*, 1954, 27: 349.

THIS is a study of one of 474 major procedures done by the combined surgical services of the Charity Hospital of Louisiana, New Orleans, from January 1, 1942 through December 31, 1951. It was found that the major factors affecting the mortality and salvage rates were the race of the patient, the clinical operative risk as based on the extensiveness of the disease, and the period of time during which the procedure was done. The last factor was of great importance because until after 1947 streptomycin was not available.

Considering the fact that most of the thoracoplasty group did not have the benefit of chemotherapeutic agents, it can be stated that on the basis of the observations on operative mortality, surgical results, and postoperative complications, no one procedure for pulmonary tuberculosis can be favored over the others.

The authors believe that when all factors are taken into consideration, their study of the surgical complications and end results does not clearly indicate an advantage of thoracoplasty or pulmonary resection over the other. They believe that the choice between collapse and resection therapy in the treatment of tuberculosis will have to be made on the basis of other criteria than those studied.

—*Beatty H. Ramsay, M.D.*

Intralobar Bronchopulmonary Sequestration. ANDRÉ J. BRUWER, O. THERON CLAGETT, and JOHN R. MCDONALD. *Am. J. Roentg.*, 1954, 71: 751.

FIVE new cases of intralobar bronchopulmonary sequestration are reported and the recent literature is reviewed. The condition consists of a cystic lesion in a lower lobe of the lung, intimately associated with a rather large anomalous artery arising directly from the lower thoracic or upper abdominal part of the aorta.

—*John J. Maloney, M.D.*

Bronchial Tumor in a Child; Tuberculous Lesions Associated with Primary Infection (Epistome chez un enfant; lésions tuberculeuses associées. Confusion avec primo-infection). J. PAILLAS, G. ROCHE, and PH. DAUMET. *J. fr. méd. chir. thorac.*, 1954, 8: 124.

THE authors reported a case of bronchial tumor in a child of 9 years, located in the right upper lobe. At first, the roentgenogram showed a dense irregular opacity over the right hilum, which seemed to be an adenopathy with periadenitis. Three years later the shadow involved the total right upper lobe. The authors thought that it was due to an obstruction of the right upper lobe from tuberculous endobronchitis and atelectasis.

The evolution was considered to be of 6 years' duration, from the first symptom to the date on which the right upper lobectomy was performed.

Bronchoscopic examination and pathologic studies of the specimen are important for the correct diagnosis. This tumor is very unusual in a child, as well as its association with tuberculous pulmonary lesions. In the early stages the confusion with primary infection is not rare.

The pathology of the tumor was shown to be of a carcinoid form. This is the more common and less malignant type. Surgical treatment in the form of resection of the part affected is the procedure of choice. This bronchial tumor is most commonly observed between the ages of 20 and 40 years and occurs more frequently in the female than in the male. Very exceptionally it is found in individuals under 10 years of age. —*Mariano Lopez Belio, M.D.*

The Determination of Operability of Cancer of the Lung by Transverse-Axial Tomography (Le diagnostic d'opérabilité du cancer broncho-pulmonaire par la tomographie transverso-axiale). E. FORSTER, D. SICHEL, E. ROEGEL, and D. LENZ. *Mem. Acad. chir., Par.*, 1954, 80: 224.

THE authors express anxiety that in their experience inoperability of carcinoma of the lung in more than 30 per cent of their cases could be established only at thoracotomy. Exploratory thoracotomy in their hands had a mortality of 5 per cent. Stimulated by the studies of Gernez-Rieux in pulmonary tuberculosis, they applied the method of transverse tomography (i.e., cutting transversely to the long axis of the body) to patients with bronchogenic carcinoma in an attempt to define gross mediastinal attachment and invasion of the tumor.

They claim that structures in the mediastinum, cylindrical or conical in the axial plane, become well separated from each other, although differentiation of structures passing obliquely (such as the arch of the aorta or the pulmonary arteries) is not good. Attempts to overcome the latter by induction of a pneumomediastinum were unsuccessful (as well as possibly dangerous).

Four cases are mentioned in which this type of tomography is claimed to have established the gross anatomical relationship of the tumor to the mediastinum. In these cases standard anteroposterior and lateral tomograms are said to have been inconclusive. The roentgenographic illustrations of these cases are not wholly convincing, perhaps because of difficulties of photographic reproduction.

This procedure is relatively safe and may well give positive criteria of operability in doubtful cases. However, some difficulty in our minds would exist in accepting such tomograms as definite contraindications to surgical excision of malignant tumors.

—*Roger H. L. Wilson, M.D.*

Bronchiogenic Carcinoma; Statistical Review of 234 Autopsies. RAYMOND M. ENGELMAN and WILLIAM L. MCNAMARA. *J. Thorac. Surg.*, 1954, 27: 227.

A GROUP of 234 consecutive autopsies on cases of bronchiogenic carcinoma are reviewed, to determine the different clinical types and the most common sites of metastases. Thirteen statistical tables are presented, with a final summary, and the literature is reviewed.

It is a widely accepted conviction that all primary cancers of the lungs, of epithelial origin, arise from the bronchi or their accessory glands. Such lesions are therefore termed bronchiogenic carcinoma.

The history of the disease and contributors to its study, the sites of origin, histopathology, the histologic types, and metastases are discussed.

The authors conclude that metastases play an important role in the treatment of bronchiogenic carcinoma, since the advent of surgery for this condition. It is noted that no organ or structure in the body escapes metastases, which may occur in any of the established routes: (1) direct extension, (2) lymphogenous dissemination, (3) hematogenous dissemination (including the cerebral veins), (4) direct implantation, and (5) bronchiogenic spread.

Carcinoma of the lung occurs with almost equal incidence on either side and the simplest classification is (1) epidermoid, (2) adenocarcinoma, and (3) undifferentiated. Combinations of these occur and would be difficult to fit into any arbitrary categorization.

The exact origin or cell derivation of each particular type of bronchiogenic carcinoma is not entirely known, but the authors believe that the epidermoid and undifferentiated carcinomas arise from the basal cell layer and the adenocarcinomas arise from the bronchial glands. —*John H. Mohardt, M.D.*

The Indications for, and the Limits of Pulmonary Resection (Indikationsstellung und Grenzen der Lungenresektion). H. GOOD and M. ZASLAWSKI. *Helvet. chir. acta*, 1954, 21: 88.

A TOTAL series of 250 thoracic operations for tumor, bronchiectasis, tuberculosis, pneumonia, and lung abscess is reported, including the preoperative diagnosis, indications, and mortality. Among 200 resections of the lung, there was a mortality of 8 per cent.

The differential diagnosis of the diseases mentioned and the cardiorespiratory function are important with regard to the postoperative prognosis for the patient. The indications for, and the limits of, resection for tuberculosis of the lung are yet in controversy. Segmental resection in early resection is gaining increasing favor, provided that suitable and appropriate use is made of chemotherapy prior to the operation.

The operative indications for resection of the lung in tuberculosis (105 cases) included: bronchostenosis and bronchial occlusion, failure of collapse therapy, tuberculous bronchiectasis, cavity of the lower lobe, tuberculoma, destroyed lung, tuberculosis associated with tumor, and solitary or multiple cavities in the upper lobe.

The total of 105 resections for tuberculosis are divided into: 50 pneumonectomies, 47 lobectomies, and 8 segmental resections. The mortality was 4.5 per cent. The series included 30 bronchostenoses and bronchiectases, 27 thoracoplasty failures, 17 cavities, 8 tuberculomas, 17 destroyed lungs, and 6 empyemas with resection of the lung.

Bronchograms and brochoscopic studies were made in the cases of bronchiectasis following the resection of the segments involved. The mortality and complications in this group were low. For lung abscesses and cysts of the lung, segmental resection or lobectomy was the method of choice. Resection in cases of chronic suppuration of the lung is confined to bronchiectases and abscesses when bronchoscopy seems to be of decisive importance in order not to overlook tumors.

Of 52 lung carcinomas, 31 were resected with a total mortality of 11 per cent. Exploratory thoracotomy is recommended, even though the x-ray find-

ings suggest inoperability. Sarcomas constitute excellent indications for pulmonary resection.

Clinical methods of examination as well as roentgen examination alone are not decisive as to operability of the patient. The functional and pathological conditions of the lung are important considerations with regard to avoiding the risk of postoperative respiratory insufficiency. —*Mariano Lopez Belio, M.D.*

HEART AND PERICARDIUM

Cardioscopy—Simple and Practical. Houck E. Bolton, Charles P. Bailey, J. Costas-Durieux, and William Gemeinhardt. *J. Thorac. Surg.*, 1954, 27: 323.

The Bolton cardioscope has been devised in order to visualize the interior of the heart. It is made of a solid rod of lucite, and may be used without the need of additional light other than the usual source of available light at the operating table. The diameter of the tube varies from 0.75 cm. to 2 cm., and its length from 10 to 12 cm. for use in the human being or from 9 to 10 cm. for use in the animal laboratory. The proximal end is expanded and beveled in order to deflect the greatest amount of light into the shaft. The distal end is oblique to facilitate its being placed against the structure to be inspected.

In the animal laboratory, it has been possible to inspect all chambers of the heart and all valves. In the human being, the instrument has been used to visualize the interatrial septum, and it may be inserted through the left or the right atrial appendage. The interior of the ventricle has been visualized in dogs, but there has been no opportunity as yet to examine the interventricular septum in the human heart. It is thought practical to do so, however, and desirable in order to differentiate between such entities as the Eisenmenger complex, high ventricular septal defect, and maladie de Roger, as well as for exact determination of the size and location of ventricular septal defects. —*Beatty H. Ramsay, M.D.*

Nil nocere: Errors, Dangers, and Mortality in Contrast-Filling of the Heart and Pulmonary Vessels (Nil nocere: Fehler, Gefahren und Mortalitaet bei der Kontrastdarstellung des Herzens und der Lungengefaesse). Helmut Roth. *Muench. med. Wschr.*, 1954, 96: 421.

The risk of contrast-filling of the heart and pulmonary vessels for diagnosis is great in itself, particularly if we consider that we are dealing with patients who already have considerable heart and lung damage. Relatively little danger is encountered with catheterization of the heart only, but additional contrast filling considerably increases the risk. Contrast media contain iodine, which can cause damage. True idiosyncrasy cannot always definitely be excluded by iodine tests prior to the examination, and chronic kidney disease can impair proper elimination of the contrast medium, with resulting uremia.

With regard to the special technique of intracardiac injection, minor complications can occur, such as blood pressure drop, nausea, headache, heat sensation, restlessness, and anxiety, as well as severe complications with long-lasting cerebral damage, total paralysis, and death.

A differentiation is made between immediate or early mortality and late complications.

Early death occurs during or up to 1 hour after the examination and is explained by shock or myocardial ischemia.

Late complications occur from 24 hours up to 14 days after the examination. They are characterized by both convulsive symptoms and paralysis, due to cerebral damage. The mortality in experienced hands is approximately 1 per cent.

Only after the evaluation of all other diagnostic possibilities should heart catheterization and contrast filling be considered.

The author emphasizes the following:

1. Contrast filling of the heart and pulmonary vessels should be done by heart catheterization rather than by the use of cardioangiography.
2. Shock should be prevented by proper medication, general anesthesia, the administration of oxygen and the use of ganglionic blocking agents.
3. An iodine test should be made before the contrast medium is injected.
4. Careful asepsis is necessary.
5. The catheter must not produce any damage.
6. Air embolism must be avoided.
7. Close observation of the patient is necessary for at least a half hour after completion of the procedure. —*Edith Simandl, M.D.*

The Development and Importance of Heart Catheterization and Contrast-Filling of the Heart Cavities and Pulmonary Vessels in the Living Human Being (Die Entwicklung und Bedeutung des Herzkatheterismus und der Kontrastdarstellung von Herzhoehlen und Lungengefaessen am lebenden Menschen). L. Loeffler and H. Roth. *Muench. med. Wschr.*, 1954, 96: 417.

A historical survey of the development of catheterization of the heart and contrast-filling of the heart and pulmonary vessels is presented. The most common techniques for these procedures—as they are used today—are discussed. Indications and contraindications, as well as possible errors, are pointed out. A great number of diseases have been evaluated by heart catheterization and thus been given opportunity for proper treatment.

The diagnostic possibilities not only justify the application of this procedure but also support its further development.

In some of the most extensive statistics an average mortality of 1 per cent can be found. Approximately 10,000 cases in which cardioangiography was practiced have been published in the world literature up to 1952. —*Edith Simandl, M.D.*

Cor Triatriatum: A Rare Malformation of the Heart, Probably Amenable to Surgery. Report of a Case, with Review of Literature. Asger Pedersen and F. Therkelsen. *Am. Heart J.*, 1954, 47: 676.

Cor triatriatum has been applied to a congenital malformation of the heart in which a transverse septum is stretching across the left atrium, separating the opening of the pulmonary veins from the mitral orifice.

The condition appears to be very rare, and in the few cases reported the diagnosis has never been suggested during life. With the rapid development of cardiac surgery, an effective treatment of this defect and in vivo diagnosis are within view. The literature is reviewed and a case is added, in which mitral disease was suggested from the clinical and physiological studies, and an explorative cardiotomy was performed, revealing a normal mitral valve.

The embryology, anatomy, pathophysiology, diagnosis, and treatment are discussed. The clinical picture is not characteristic; the symptoms have merely been those of pulmonary hypertension and congestion with subsequent right ventricular failure, and neither stethoscopy, electrocardiography, nor roentgenography have improved the diagnostic possibilities. Heart catheterization should be strongly suggestive of mitral disease; an apical diastolic murmur and a left auricular enlargement may or may not be present. Angiocardiography has never been used on these patients. Regarding the possibility of successful surgical interference, this rare defect should be considered in obscure cases of pulmonary hypertension, especially when high "pulmonary capillary pressure" has been found. At the present time an in vivo diagnosis definitely can be made only by exploratory thoracotomy.

The case of a 29 year old woman with increasing cardiac distress is reported. No murmur could be heard. The heart was not enlarged, but a prominent second left arch and pulmonary congestion were found on the roentgenogram. The lower lobe of the left lung was markedly emphysematous. The electrocardiogram showed right ventricular hypertrophy. Heart catheterization indicated pulmonary hypertension and increased pulmonary capillary pressure. Mitral disease was suggested and thoracotomy demonstrated a normal mitral valve and normal pressure in the left atrium was measured directly.

Autopsy revealed a transverse septum with only one small perforation separating the opening of the pulmonary veins from the other parts of the atrium.

A review of the literature is presented, concerning anomalous, congenital structures within the left atrium. Thin cords or even broad bands across the lumen have no significance. The real cor triatriatum is a serious congenital defect since most of the afflicted die shortly after birth or childhood, and few reach adulthood as many die from irrelevant causes or congestive failure. The possibility of an effective surgical treatment is discussed. —*John H. Mohardt, M.D.*

Surgical Closure of Atrial Septal Defect: Response in a Patient with Severe Pulmonary Hypertension. S. Gilbert Blount, Jr., Malcolm C. McCord, and Henry Swan. *Am. Surgeon*, 1954, 20: 305.

The present case report is concerned with the successful closure of an atrial septal defect in a 26 year old woman. At the age of 5 years, this patient was confined to bed for a period of 1 year because of her cardiac status. Dyspnea and fatigue increased, markedly limiting her tolerance for any kind of work. At the time of admission to the hospital she was unable to walk one city block. Physical examination showed enlargement of the heart to the left anterior axillary line with a systolic thrust, followed by a palpable shock in the left second intercostal space. On auscultation, a grade III systolic murmur was heard in the left third intercostal space. The electrocardiogram was interpreted as indicating right ventricular hypertrophy, right bundle branch block, and right atrial enlargement. On fluoroscopy, the main pulmonary artery and its branches showed increased pulsations. On cardiac catheterization, a persistent left superior vena cava was demonstrated as well as a left to right shunt at the atrial level. Pulmonary arterial pressure averaged 100/30 mm. Hg.

Thoracotomy was done through a trans-sternal approach. Hypothermia was created by immersion of the patient in an ice bath. The operation was performed under direct vision and occlusion of the cardiac inflow for a period of 7½ minutes. A defect 2½ by 4 cm. was located in the right atrium and directly closed.

The postoperative course was complicated by supraventricular cardiac arrythmia, shock, and partial aphasia, all of which subsided within 48 hours. Since her discharge from the hospital the cardiac status of the patient has improved. She can walk a half mile without discomfort. Roentgen films show a decrease in the size of the heart shadow. Cardiac catheterization shows normal oxygen saturation of mixed venous blood at the pulmonary arterial level. Pulmonary arterial pressure has fallen to 30/17 mm. Hg. —*B. G. P. Shafiroff, M.D.*

Protection of the Heart by Arterialization of the Coronary Sinus. Coronary Flow in Dogs With Aorticocoronary Sinus Anastomosis. Alvin A. Bakst, Jaime Costas-Durieux, Harry Goldberg, and Charles P. Bailey. *J. Thorac. Surg.*, 1954, 27: 442.

This is the second of a two part article covering different aspects of the same subject.

Repeated experiments by other authors have shown that arterialization of the coronary sinus affords protection against the uniformly fatal procedure of ligation of the circumflex branch of the coronary artery. In addition, besides the decreased mortality that results, the incidence of ventricular fibrillation and myocardial infarction is greatly reduced.

In the first of the authors' articles, they established control values for the volume and oxygen content of the retrograde blood flow from the distal segment of the ligated circumflex coronary artery. They also determined control values for the pressure within the coronary sinus and the oxygen content of the blood within it. Simultaneously drawn samples from the aorta, pulmonary artery, coronary sinus, and the distal end of the ligated circumflex artery were studied for oxygen content.

With these values at hand, in this series of experiments, the authors determined these same values after arterialization of the coronary sinus. This was done in two stages: in the first, an external jugular graft was placed between the aorta and the coronary sinus by an approach from the left, and in the second, by an approach from the right, the entrance of the coronary sinus being ligated at the right atrium over a probe for 2 to 3 mm. Four to 8 weeks after these procedures, the physiological data were obtained by cannulization of the appropriate structures.

After the arterialization procedure, the retrograde flow from the distal segment of the ligated circumflex coronary artery averaged 7.1 c.c. per minute as compared to a control value of 1.7 c.c. The oxygen content of this blood was on the average 6.3 volumes per cent as compared to the normal value of 14.5 volumes per cent.

An interesting finding was that after occlusion of the graft, the retrograde coronary flow was still 4 times greater than that of the normal dog and was arterial in nature, which indicated an increase in the interarterial coronary collateral flow following the arterialization procedure.

It was seen that the retrograde flow from the ligated coronary artery was greatly increased in volume and that the blood was no longer arterial, but definitely venous in nature. This indicated a complete reversal of flow through the myocardium and proved that there was definite extraction of oxygen as the oxygen content was much lower than at the coronary sinus where the gradient of flow started.

During the course of the experiments, ventricular fibrillation was less common in the animals with the arterialized coronary sinus, but no studies were conducted to show the effectiveness of the operative procedure in protecting against coronary artery ligation, a fact that has been amply shown before.

—*Harold M. Unger, M.D.*

Protection of the Heart by Arterialization of the Coronary Sinus. Coronary Collateral Flow in Normal Dogs and in Dogs Having Had Previous Nondescript Cardiac Surgery. ALVIN A. BAKST, JAIME COSTAS-DURIEUX, HARRY GOLDBERG, and CHARLES P. BAILEY. *J. Thorac. Surg.*, 1954, 27: 433.

IT HAS been shown by many workers that arterialization of the coronary sinus provides for adequate protection to the heart during major coronary artery ligation. Whereas the mortality from major coronary artery ligation varies from 60 to 100 per cent without arterialization of the coronary sinus, this mortality can be reduced to as low as 20 to 30 per cent by the procedure of arterialization. Since this procedure is of importance in the surgical therapy of occlusive coronary artery disease, the authors performed a series of experiments in an attempt to explain the physiological basis for the protection afforded by the arterialization procedure.

The points to be evaluated were (1) whether or not the myocardial capillary bed can actually be perfused in a retrograde fashion, (2) if such retrograde flow occurs, whether or not oxygen is extracted during the passage through the myocardium, and (3) whether or not there is an increase in the interarterial coronary collateral flow. Using normal dogs and dogs upon which previous nondescript cardiac surgery had been performed, the authors determined the following: (1) the coronary sinus pressure and the oxygen content of the coronary sinus blood, (2) the quantity of retrograde flow from the circumflex coronary artery, after its ligation, from a point distal to the ligature, and (3) the oxygen content and saturation of simultaneously drawn blood specimens from the pulmonary artery, aorta, and the distal segment of the transected circumflex coronary artery.

Several important conclusions can be drawn from the results of these experiments, which consisted essentially of the cannulization of the structures mentioned for the purpose of measuring the pressures and obtaining the desired blood samples. Most important is the fact that the retrograde blood obtained from the distal segment of the ligated circumflex coronary artery in the normal dog is highly oxygenated, approximating the oxygen content of simultaneous specimens from the aorta. Because of the high oxygen content and the continuous nature of the flow, averaging 1.7 c.c. per minute, it is believed that its source must be the neighboring coronary arteries (the flow running through small interarterial communications) and therefore it must represent the coronary collateral blood flow. For this reason the measuring of the retrograde flow from the ligated coronary artery provides an easy means of determining the effectiveness of any procedure which attempts to increase the coronary collateral flow.

The mean coronary sinus pressure was 6.1 cm. of water, and the oxygen content of the coronary sinus blood was found to be 4.5 volumes per cent.

Ligation of the circumflex coronary artery, as in previous studies, produced a 100 per cent mortality. Ligation of the anterior descending branch produced only a 60 per cent mortality and this was attributed to the high incidence of an accessory left anterior descending branch arising from the circumflex artery in the dogs which survived the ligation.

This is the first of a series of two articles on the same subject.

—*Harold M. Unger, M.D.*

Congenital Pulmonary Stenosis. ROWAN NICKS. *N. Zealand M. J.*, 1954, 53: 10.

THE author describes the surgical treatment of pulmonary stenoses at the Green Lane Hospital in Auckland, New Zealand. Six patients with pulmonary atresia and the tetralogy of Fallot were operated upon. Of these, 4 demonstrated continuous murmur, indistinguishable from that produced by a patent ductus arteriosus. The murmur indicates the size of the fistulous shunt from bronchial to pulmonary arterial systems. Pleurectomy to cause vascular adhesions was unsuccessful in 2 patients, one of whom died. Blalock-Taussig type anastomoses were completed in 3 patients. Improvement was obtained in the patients who survived their operations. One patient was improved by simple dilation of the atretic pulmonary artery stem.

"Pure" pulmonary stenosis was found in 9 cases. The policy of Brock is recommended: to operate in all cases of right ventricular systolic pressures in excess of 75 mm. of mercury at rest, because disability as a reason for operation may come late, only after heart failure appears. The operative technique of Brock was used in 8 of the 9 cases, and in 2 cases of infundibular stenosis. The valve is probed, incised, and dilated through an incision in the right ventricle. Two patients died after the operation. In one, a 33-year-old woman, the valvular stenosis was relieved but there was an associated and unaffected subvalvular muscular obstruction. The other patient, age 10, succumbed to complications of endocardial thrombus originating at the ventricular incision. A smouldering bacterial

endocarditis was activated by the operation in the same patient. All patients who survived have been benefited.

More common than pure pulmonary stenosis is valvular stenosis with tetralogy of Fallot. In that group a significant number of patients have associated infundibular stenosis. The direct release of the pulmonic obstruction is superior to indirect methods (Blalock-Taussig procedures) to increase pulmonary blood flow. The Brock operation was performed in 5 cases of tetralogy of Fallot, 3 with valvular stenosis, and 2 with combined valvular and infundibular stenosis. There was no operative mortality. The initial results have been good, with relief of dyspnea, cyanosis, and clubbing.

Infundibular stenosis without valvular disease is the most significant part of most tetralogies of Fallot. In that disorder, the outflow tract is separated from the main cavity of the right ventricle by a diaphragmatic or muscular stenosis. Even if the entire infundibulum is hyperplastic, one region of narrowing causes the main obstruction: high, near the valve; intermediate, demarcating a small subvalvular chamber; or low, at the base of a well developed cavity in the infundibulum.

In the years preceding 1952, Blalock-Taussig type operations were performed in all suitable cases (54). There were 7 operative deaths, and 3 patients have died since. In another 14 cases, thoracotomies with or without palliative pleurectomies were performed. One patient with pulmonary atresia died. Although pleurectomy has been of real benefit in only 1 case, it was done as a final resort in 8. However, thoracotomy alone has demonstrated its worth by proving diagnoses and permitting evaluation of further surgery in cases in which anastomoses are not feasible. Of 26 patients who have survived the anastomosis operations, 21 have had excellent or good results, 2 have had fair results, and 1 has had a poor result. Two patients were operated on too recently for the results to be fairly evaluated.

In spite of these good results, direct resection of the infundibular obstructions has replaced anastomoses as the treatment of choice since 1952. Nine patients have been operated upon and 2 have died. One of the 2 had cardiac arrest after respiratory obstruction by mucus. The other had had an anastomosis which had become occluded, and was unrelieved by punch resection because a double infundibular system existed, only one part of which was opened by surgery.

In any case, the choice of operation should be decided on its individual merits. A left thoracotomy for adequate transpericardial evaluation, and routine electromanometry of the chambers and great vessels are employed in most cases.

When pressures in the right ventricle are high, in the presence of intermediate infundibular stenosis or valvular stenosis, or if a localized change in pressure indicates diaphragmatic obstruction, direct resection is the favored method. If the ventricular pressure is low, if the stenosis is not distinct, or if the stenosis is high, close under the valve, so that a resecting instrument is likely to injure the valve, anastomosis is the recommended procedure.

—Leonard D. Rosenman, M.D.

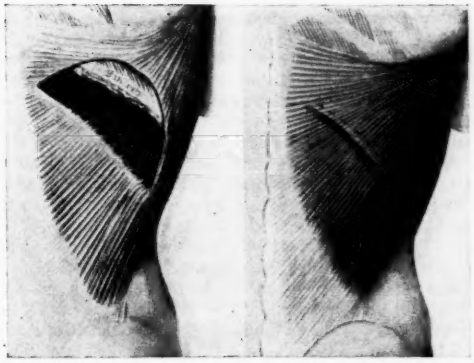

FIG. 1 (Hartl). a, The U-shaped flap is inserted intrapleurally. b, Closing of the pleural cavity. (Courtesy of J. B. Lippincott Co., Ann. Surg., 115: 745, 1942.)

Plastic Surgery of Muscle, After Rives, in Defects and Relaxation of the Diaphragm (Muskelplastik nach Rives bei Defekt und Relaxation des Zwerchfelles). HERMANN HARTL. *Thoraxchirurgie*, 1954, 1: 510.

THE author discusses the indications and technique of plastic surgery for repair of diaphragmatic hernia and reports 2 cases of his own. In a third case he used the same method for treatment of relaxation of the diaphragm.

Technical difficulties in covering the defect arise especially in large and peripherally located hernias. The writer uses the method first published by Rives in the United States in 1942. A U-shaped pedunculated flap is taken from the latissimus dorsi muscle and after resection of the ninth, tenth, or eleventh rib it is introduced into the pleural cavity and used for covering the defect of the diaphragm.

Relaxation of the diaphragm is a rare condition of unknown origin. The diaphragm in its entirety is displaced into the thoracic space. It does not contract actively but acts like a flaccid membrane. Different theories have been offered concerning the pathogenesis of this condition: damage to the phrenic nerves, degenerative changes of the muscle fibers, and muscle atrophy with lipomatous pseudohypertrophy. The clinical symptoms include pains which irradiate into the left arm, dypepsia, belching, and dyspnea. The author describes one such case in which the Rives operation was successful and a complete cure was accomplished. *—Werner M. Solmitz, M.D.*

Cessation of Circulation in General Hypothermia. Techniques of Intracardiac Surgery Under Direct Vision. HENRY SWAN and IRVIN ZEAVIN. *Ann. Surg.*, 1954, 139: 385.

STUDIES have shown that inflow occlusion of the cardiac circulation is better tolerated than outflow occlusion. In the normothermic animal, inflow tract occlusion can be tolerated with almost no risk to the animal for 1.5 minutes, although up to 4 minutes is tolerable in experimental work. Beyond this the mortality rises precipitously because of ventricular fibril-

lation and cerebral anoxia. The previous experimental and clinical use of hypothermia with cessation of the circulation is briefly reviewed. The authors have found that hyperventilation and its attendant elevation of the *p*H greatly reduce the incidence of fibrillation in occlusion. They have also shown that hypothermia plus hyperventilation reduce the serum K. By the injection of serum K into the coronary circulation, defibrillation has been accomplished chemically in hypothermic dogs and human beings which are refractory to electrical defibrillation.

The authors report 16 cases of open heart surgery under hypothermia with 2 deaths. The patient is anesthetized with pentothal and ether and an endotracheal tube is passed. When the patient is stabilized in the third plane of anesthesia, he is placed in a tub of ice water (2 to 4 degrees C.). Deep rectal temperatures are taken continuously. The rate of cooling depends on the size of the patient, so that larger patients with more adipose tissue cool more slowly. The patients are cooled to 21 to 27 degrees C. The cooler, the greater the risk of arrhythmia but the less danger there is from cerebral or other tissue damage. Patients requiring less intracardiac operating time, such as those with pulmonary stenosis, are maintained at a slightly higher temperature than those requiring a longer time, such as those with iteratrial septal defects.

Once cooled, there is no tendency for the temperature to rise until active measures are taken to produce warmth. At the end of the procedure the patients are placed in water at 45 degrees C. until their body temperatures reach 32 to 34 degrees.

The surgical approach is through a transsternal bilateral thoracotomy in the fourth interspace. The azygos vein is ligated and the superior and inferior vena cavae are surrounded with umbilical tape. The cavae are occluded; 45 seconds are allowed for the heart to empty itself and a clamp is then placed at the root of the aorta with certainty that the coronary ostia are occluded. This prevents air from entering the coronary circulation. The pulmonary artery is clamped and tourniquets are tightened around each lung root, which prevents pulmonary venous return to the left atrium, which would obscure the field. Prior to arrest of the circulation the cardiac incision is made over a noncrushing clamp so that no time is lost. At the end of the intracardiac manipulation, the chest is filled with saline solution to expel all of the air from the chambers, and then the cardiac incision is clamped. The clamps and tourniquets occluding the lung roots, aorta, and pulmonary artery are removed. The tape around the superior vena cava is slowly released, and when the myocardium seems to be pink and adequately responding to the increasing work load, the inferior vena cava is slowly released. The cardiotomy incision is now sutured, having previously been closed by a noncrushing clamp, and the pericardium is loosely closed if it does not fit too tightly.

This technique has given good clinical results in pulmonary valvular stenosis. The pulmonary artery is opened just above the valve, the structure is incised in 2 or 3 places toward the valve ring, and portions of the stenotic tip may be excised. Infundibular pulmonary stenosis, seen with the tetralogy of Fallot, has been incised under direct vision through a right ventriulcar cardiotomy in 2 patients. However, technical difficulties prevented closure of the interventricular septal defect at the same time. Both of the patients have done well. Five patients with interatrial septal defects were treated by direct vision closure through the right atrium with excellent results in 4 and death in 1 patient. Because of the very large chambers on the right side in this lesion, much blood is lost. The pulmonary roots must be occluded to prevent pulmonary venous return from obscuring the field. Care must be taken to prevent air embolism by filling the left atrium with saline solution before the last suture closing the defect is tied.

In the event of ventricular fibrillation, a 1 meq./c.c. solution of potassium chloride is injected into the coronary circulation. In case of asystole massage is tried and if this fails, a similar concentration of calcium chloride is used. Adrenalin is avoided as it incites fibrillation. If these measures fail the patient's temperature should be raised a few degrees while the circulation is maintained manually.

The technique described in this article has been successfully used in both children and young adults.

—*Victor M. Bernhard, M.D.*

Persistent Left Superior Vena Cava; Survey of the World Literature and Report of 30 Additional Cases. Fred S. Winter. *Angiology*, 1954, 5: 90.

In the world literature, 174 cases of persistent left superior vena cava have been previously reported. All of these were observed during autopsy or in anatomical specimens. The author adds 30 more cases, observed during the past 6 years, including 8 verified by surgical exploration and 12 diagnosed by clinical methods.

Persistent left superior vena cava is derived from the left cardinal vein system. The cephalad portion is an anterior cardinal remnant, while the caudal component is derived from the postcardinal system. These structures normally disappear in man, but persist in certain lower animals so that adult animals have both a right and a left superior vena cava. The uppermost portion of the left superior vena cava in man persists normally as the trunk of the left superior intercostal vein, the remainder disappears completely or sometimes persists as a fibrous strand or cord.

When this structure persists as an actual vessel, it arises at the level of the left innominate vein, extends downward in front of the aorta, runs to the medial side of the left vagus nerve, then in front of the hilus of the lung, and finally terminates in the coronary sinus and the right atrium. The left innominate vein may be present as an anastomosis between the right and left vena cava, or may be absent. In the latter cases, the left vena cava is very large, being equal to the right vena cava in size.

The hemiazygos vein frequently loops over the bronchus to enter the left superior vena cava, just as the azygos vein does on the right side. The coronary sinus tends to be larger than normal, particularly when the anastomosis at the left innominate vein is small or lacking. The right superior vena cava in these cases may be somewhat smaller than the left, but usually retains normal anatomical relationships.

Several variations from the description are enumerated and diagrammed. The most frequent variation

was complete absence of the right superior vena cava. Among the 174 world literature cases reviewed, this structure was absent in 31. In 3 of these the single left superior vena cava entered the left atrium and in 3 other cases it entered a common atrial chamber.

In 9 cases, the ostium of the coronary sinus into the right atrium was closed, and blood from the coronary veins reached the right atrium by way of the left superior vena cava, innominate vein, and right vena cava.

There was great variation in the drainage of the pulmonary veins. There were 28 cases with such anomalous patterns, with drainage of all or part into the right or left atrium, right or left superior vena cava, a common atrial chamber, or into more than one of these structures. For example, in 2 cases all the pulmonary veins drained into the left superior vena cava and thence into the left atrium. In 3 cases, all pulmonary drainage was into a partially persistent left superior vena cava that did not reach the atria, so pulmonary blood travelled by way of the innominate anastomosis and right superior vena cava to reach the right atrium. In all but one of the cases of pulmonary vein anomalies, associated cardiac septal defects were present. In the cases in which the entire pulmonary drainage entered the left atrium, septal defects were obviously essential to allow oxygenated blood to reach the general circulation. The complex embryology of the heart and great vessels is reviewed with reference to the development of the described anomalies.

Other anomalies present were 13 cases of transposition of the great vessels, 10 cases of patent ductus arteriosus, 10 cases of aorta over-riding a defective ventricular septum, and 6 cases each of truncus arteriosus communis, and coarctation.

In the 30 new cases added to the literature, there were 12 in which actual exploration or postmortem examination was not done. Cardiac catheterization and angiocardiographic studies were used in the diagnosis. Variations and anomalies in this series were similar to those in the world literature. In 24 cases the left superior vena cava entered the right atrium by way of the coronary sinus. In 4 cases, it entered the left atrium directly (with septal defects present), and in the remaining 2 the left vena cava was only partially persistent, the lower end not reaching the heart. Only 3 cases had pulmonary vein anomalies. There were 25 cases with cardiac septal defects.

Aortic or pulmonary artery defects were present in one-half of the 30 patients. The tetralogy of Fallot was present in 7 instances, coarctation of the aorta in 2, truncus arteriosus in 1 case, and patent ductus arteriosus in 5 cases.

In contrast to the 174 cases from the world literature, all postmortem specimens, 25 of the 30 new cases were diagnosed in living subjects by means of angiocardiography and cardiac catheterization. Plain chest films are apparently not a useful diagnostic measure in this anomaly. In retrospect, in only 4 of the 29 preliminary chest roentgenograms taken was a definite shadow present. This consisted of a strip of decreased density along the left margin of the upper mediastinum. In 2 other cases in which angiocardiography demonstrated a left superior vena cava projecting well beyond the mediastinal border, no shadow could be detected on the plain film.

The left antecubital vein was the approach most likely to demonstrate this anomaly, either by catheterization or angiocardiography. In the latter, use of the right antecubital vein or a femoral vein may fail to demonstrate a persistent left superior vena cava. Catheterization is the most consistent method of demonstrating this anomaly. Each of the 30 new cases is reported in detail. —*Stanley W. Tuell, M.D.*

ESOPHAGUS AND MEDIASTINUM

The Early Diagnosis of Carcinoma of the Esophagus. Edward F. Parker. *Am. Surgeon*, 1954, 20: 424.

The author pleads for a more vigorous investigation at an early date to detect carcinoma of the esophagus. The reason for this plea is a previous report of his showing that of 170 cases of primary carcinoma of the esophagus there was but 1 survival after 3 years, an incidence of 0.6 per cent.

The present study is taken from 187 cases of primary epidermoid carcinoma, all proved histologically, seen at the Cancer Clinic of the Medical College, and in the Roper Hospital, Charleston, South Carolina, during the period between January 1940 and March 1951. Of these cases it was thought that 69 had been diagnosed as early as could reasonably be expected, whereas in 17 cases there was a significant delay in establishing the diagnosis.

It is interesting that in this series, 6 patients having negative radiographic studies of the esophagus were proved by biopsy to have carcinoma. Inasmuch as the radiology department of this institution is staffed with highly trained and co-operative radiologists, this observation impresses one with the great need for single or multiple esophagoscopic examinations in any patients having suggestive symptoms.

—*Matthew H. Evoy, M.D.*

MISCELLANEOUS

The Diagnosis and Surgical Management of Chylothorax with the Aid of Lipophilic Dyes. Roy G. Klepser and James F. Berry. *Dis. Chest.*, 1954, 25: 409.

The authors emphasize a simple and specific test for chylothorax due to rupture of the thoracic duct in which the patient is fed a fat meal containing a lipophilic coal-tar dye. The dye becomes grossly detectable in the pleural fluid obtained by thoracentesis a few hours later if the thoracic duct is leaking alimentary chyle. Regardless of the site of rupture, supradiaphragmatic ligation of the thoracic duct will then prevent further leakage and will cure the patient of the chylothorax.

With more radical neck and posterior mediastinal dissections being done, the incidence of surgical trauma to the thoracic duct can be expected to increase. Because so many operative procedures endanger the duct, every surgeon should recognize the consequences and know the course to be followed when the thoracic duct is accidentally severed.

Nontraumatic chylothorax, usually following rupture due to neoplastic invasion or mechanical obstruc-

tion of the duct, is more common but the diagnosis seldom is made before autopsy. The basis of the present report is 6 cases of chylothorax and 1 case of chyloperitoneum in which the diagnosis was made or verified by the use of oral lipophilic dyes. Three of these patients responded favorably to transthoracic ligation of the duct, and closure was spontaneous in 2 patients; the rest, in whom ligation was not done, died. Each of these patients had presented difficulties in diagnosis and it is doubtful if the condition in several would have been recognized without the use of lipophilic dye tests.

The authors advise the use of a green or purple innocuous dye in oleomargine or butter as the vehicle of transmission of the coloring agent. Their experience indicates that red dye is not a good contrast medium inasmuch as there is often a reddish or pinkish hue from bleeding in the operative field. The time of introduction of the dye-stained fat into the stomach varied from a period of 3 to 12 hours before the operation.

A review of the anatomical and physiological contions is presented. The course of the thoracic duct is shown to be along the vertebral bodies between the aorta and azygos vein, passing upward in close proximity to this vein and usually showing demonstrable branches running into the vein. The duct runs along the right side of the vertebral bodies to the fifth thoracic vertebra where it crosses the midline to pass behind the arch of the aorta and empty into the left subclavian vein near its junction with the internal jugular vein.

It has been demonstrated that there is a remarkable tendency for collateral lymphatic channels to develop after ligations. Connections to the inferior vena cava, intercostal vessels, lumbar veins, and even the renal and mesenteric veins are reported. This capacity to form collateral paths is so strong that it is difficult to produce a complete block.

Following experimental ligation of the thoracic duct there is no demonstrable nutritional disturbance. Blood fat levels decrease immediately but return to normal within 2 or 3 weeks. The circulating lymphocytes also decrease 50 per cent after ligation, but return to normal within a few weeks. There is certainly much less physiologic upset with ligation than with complete severance and chylothorax. The organism adapts to a ligated duct, but cannot tolerate the loss of chyle from a fistula. It is difficult to understand the reluctance with which elective ligation to the duct has been approached in the past. It seems to be a relatively harmless procedure, fraught with no greater dangers than ligation of any of the great veins, and is curative for an otherwise fatal disease.

Chyle differs from serum in that there is a smaller amount of protein but a much larger amount of fat. It contains fibrinogen and prothrombin, but is low in thromboplastin and contains no platelets. There is a hemolytic action due to the soaps and fatty acids, but rapid dilution in the blood stream prevents actual hemolysis. The authors point out that the lipophilic dyes were checked by the Cosmetic Division of the Pure Food and Drug Administration before they were used in their cases. The dyes they used most were D and G green No. 6 rather than the dyes of other colors. A useful observation is the fact that aspirated chyle, when stirred with a glass rod, forms a curd which adheres to the glass rod and, strangely, this curd takes or shows all of the stain that might not be visible in the diluted specimen. In a few cases they suspected that the dye had not entered the reservoir of chyle, but found to their amazement that the agitated curd was definitely colored with the ingested dye. —*Matthew H. Evoy, M.D.*

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Peritoneal Tap as an Aid in the Diagnosis of Acute Abdominal Disease. WILLIAM H. MORETZ and WILLIAM G. ERICKSON. *Am. Surgeon*, 1954, 20: 363.

THE study of aspirated peritoneal fluid may yield information to differentiate causes of abdominal pain. There is little danger of entering a freely mobile loop of intestine with the aspirating needle, and very little risk even if a loop is adherent to the area of abdomen pierced. Furthermore, the dangers of penetration, if it occurs, are negligible. That has been demonstrated by experiments with random needle punctures of the abdomens of dogs. Certain risks may be avoided by needling the lower lateral or upper midline areas, after the bladder has been emptied. In that fashion, the inferior epigastric vessels and solid viscera will not be struck. An attempt should be made to avoid areas of relatively increased bowel distention. A 2 inch No. 18 spinal puncture needle is preferred, and should be inserted into the dependent portion of the abdomen after the patient has lain on his side for a short time. If free fluid is encountered, it should be aspirated for study; if no fluid is found even after manipulating the needle, the aspiration product should be emptied into a glass slide, and should be examined for pus cells or bacteria. Routine study includes evaluations of gross characteristics, *p*H, acidity, smear (Wright's and Gram, stained and unstained) cultures, and amylase content.

The authors described the cases of 75 patients who yielded 57 samples by tapping, 11 samples at laparotomy, and 7 specimens removed at operation, but which had not been produced by tap. Sixteen patients who gave dry taps were proved truly to be dry. In addition to the 7 removed at operation there was thought to be an eighth, but unproved, falsely negative tap. There were 2 falsely positive taps; one had an extraperitoneal hematoma, another a renal cyst. Both lesions were aspirated. There were no complications after the taps.

TABLE VI.—SUMMARY OF USUAL CHARACTERISTICS OF FLUID ASSOCIATED WITH VARIOUS DIAGNOSES

Diagnosis	*No. of Cases*	*Gross Appearance*	*pH*	*Smears*			*Amylase*
				White blood cells	*Red blood cells*	*Bacteria*	
Intra-abdominal hemorrhage (rupture of solid organ, ectopic preg., etc.)	7	Whole blood	Alk.	0–1+	4+ (norm. blood smear)	0	
Intestinal obstr. with infarction of bowel	7	Bloody to serosanguineous	Alk.	1–2+ (more if late)	3–4+	0 (1–2+ if late)	11.3× normal blood content (serum amylase less elevated)
Without serious strangulation	8	Straw-colored	Alk.	0–2+	0–2+	0	Not elevated
Perf. of duodenum or stomach	10	Cloudy, yellow or brown occ. green	Alk. (occ. acid)	2–3+	0–1+	0–1+	9.3× normal blood content (serum amylase only slightly above normal)
Pancreatitis, acute (relatively mild)	4	Cloudy yellow to reddish brown	Alk. 3+		1–3+	0	6.3× normal blood content (serum amylase elevated less)
Peritonitis, secondary to:							
1. Acute appendicitis with perf.	8	Purulent fecal odor	Alk.	4+	0–1+	2+ (Gram neg. rods)	
b. Acute cholecystitis with perf.	2	Purulent	Alk.	3+	0–2+	0–1+	
c. Mesentericthrom. (late)	1	Bloody, purulent	Alk.	3+	3–4+		
Intra-abdominal abscess	2	Purulent	Alk.	4+	0	2+	
Acute appendicitis	3	*Milky*	Alk.	3+	0	0	
Serositis (active rheum. fever)	2	Serous	Alk.	2+ (mostly lympho)	0	0	
Ascites	3	Serous, sl. turbid	Alk.	2+ (mostly lympho)	0–1+	0	Not elevated
Carcinomatosis	3	Serous to bloody	Alk.	1–2+	0–4+	0	Not elevated

The authors tabulate the findings in the various diseases encountered and correlate their observations of the tapped-off fluid. —*Leonard D. Rosenman, M.D.*

GASTROINTESTINAL TRACT

Treatment of Acute Gastroduodenal Hemorrhage with Particular Reference to Quantitative Blood Replacement. F. W. Gunz, I. D. Gebbie, and R. C. S. Dick. *Brit. M. J.*, 1954, p. 950.

At Christchurch Hospital the treatment of acute gastroduodenal hemorrhage was reviewed and a method of management was instituted, beginning in May, 1952 and carried out and studied statistically for a period of 1 year. The patients with acute gastroduodenal hemorrhage during this year were then treated by the following regime: (1) initial treatment by conservative measures; (2) early estimation, by means of a blood-volume determination, of the amount of blood lost; (3) quantitative replacement of the blood lost; (4) repetition of the blood-volume estimation to determine if hemorrhage had ceased or had recommenced; (5) early surgical intervention in cases of hemorrhage continuing or recurring in spite of conservative treatment.

The authors believed that it would be improbable to be able to gauge the extent and duration of bleeding by means of the usually employed methods—namely, an analysis of the clinical features plus estimations of the hemoglobin content of the peripheral blood. The principal change in their regimen, therefore, was the use of blood-volume estimation by means of the Evans blue dye method for determining the plasma volume. After some experience with this method they were able to remove or correct for inaccuracies, and found the method satisfactory.

Contrary to many previously published reports and methods of treating acute gastrointestinal hemorrhage, the authors felt that the prompt replacement of lost blood was the single most important measure in the conservative management of bleeding ulcer. By charting the initial hemoglobin readings against the initial red cell mass, they found that among the 10 patients with levels exceeding 12 gm./100 ml., the initial total red cell mass varied from 43 to 81 per cent of normal, and the quantity of blood required to raise it to normal varied from 2½ to 9½ liters. Also, by means of repeated blood-volume estimations they were able to come to a definite decision as to whether bleeding was continuing, and were able to distinguish between the two causes of a falling hemoglobin level—hemodilution and continued bleeding.

They acknowledge the fact that when symptoms and signs of shock are present, transfusion is obviously a matter of urgency, but point out that patients may lose large amounts of blood without accompanying shock, and that these patients quickly develop severe shock if further bleeding takes place and then the problem of resuscitation is made much more difficult, if not impossible. Furthermore, they point out that the presence of anemia impairs the action of organs such as the heart, liver, and kidneys, and probably also the chances of healing at the ulcer site. Patients over fifty years of age are progressively less tolerant of anemia, which is probably the main reason for the rising mortality in acute gastrointestinal hemorrhage in the older age groups. In this series of cases, significantly, nearly 80 per cent of the patients were over 50 years of age.

In using massive replacement transfusions, care was used to run the blood slowly so as to increase the blood volume and raise the blood pressure gradually, but they did not see any evidence suggesting that the complete replacement transfusions were responsible for recurrent bleeding, and in only 1 case was there even a suggestion of the possibility of over-transfusion having occurred.

The other therapeutic measures employed included colloidal antacids used generally in an early stage, especially where pain was present; a diet given as tolerated by the patient, starting preferably with sips of fluid during the first 12 hours, and then a semi-liquid gastric diet as soon as the patients tolerated it comfortably; and sedation (avoiding morphine because of its tendency to produce vomiting) to allay the apprehension and to be supplemented by careful explanation by the doctor to reassure the patient.

Surgery was used on two classes of patients: (1) those who, in spite of conservative treatment, including adequate blood transfusion, showed evidence of bleeding at the end of 48 hours' observation in the hospital; (2) those who, following cessation of the original hemorrhage, showed evidence of recurrent bleeding while still in the hospital.

The experimental series of cases was then compared with a second unselected series of 93 patients with acute gastroduodenal hemorrhage who were treated at Christchurch Hospital during the 18 months immediately preceding the introduction of the new regimen. These two series of cases compared very favorably as to age and sex distribution, although the patients in the series preceding the experimental series were slightly younger. The amount of blood given in the experimental series of cases averaged 7.9 pints, whereas in the control series the amount averaged only 2½ pints per patient. The percentage of emergency operations performed averaged about half that in the experimental series. The mortality rate in the control series was 17.2 per cent and in the experimental series 7.5 per cent, a reduction of over 50 per cent in the total mortality, a statistically significant reduction. —*Frederick C. Hoebel, M.D.*

The Diagnosis and Surgical Therapy of Gastric Corrosion Due to Hydrochloric Acid (Zur Diagnose und chirurgischen Therapie der Magenveraetzungen mit Salzsaeure). Wolfgang Koele. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1954, 278: 43.

The effects of hydrochloric acid ingestion, suicidal or accidental, are of interest to the surgeon because of the stenosis which may follow. Three stages of pathologic change are recognized. The first stage includes the systemic reaction due to absorption of the poison and the acute erosive effects on gastric and esophageal mucosa, causing vomiting of blood and mucus. The second stage is characterized by a corrosive gastritis, with phlegmonous changes in the stomach wall leading, in some instances, to hemorrhage or perforation. Those patients who survive the first

two stages may become surgical candidates after 3 to 4 weeks because of stenosis, the main feature of the third stage. Stenosis may occur in the cardia or the pylorus, along the stomach (hourglass), or may involve the entire organ.

Eighteen cases of stenosis due to corrosive ingestion were seen at the Surgical Clinic at Graz during the period between 1940 and 1953. In 15 of these the condition was due to the swallowing of lye, in 2 cases it followed the ingestion of hydrochloric acid, and in 1 case it followed lysol ingestion. Lye ingestion usually resulted in esophageal stenosis, while the 2 cases of strong acid ingestion led to gastric stenosis—at the pylorus in 1 case and an hourglass deformity in the other.

The diagnosis is made on the basis of the history and x-ray examination. A Billroth I gastric resection is the treatment employed.—*Harold Laufman, M.D.*

A Roentgen Study of the Gastrointestinal Tract in Proved Cases of Sarcoidosis, with a Review of the Literature. STANLEY H. LORBER, HARRY SHAY, and HENRY WOLOSHIN. *Gastroenterology*, 1954, 26: 451.

SARCOIDOSIS rarely involves the gastrointestinal tract. In a review of the literature, the authors encountered more than 100 autopsied cases of sarcoidosis and found only 8 in which the gastrointestinal tract was involved by this disease. Localized sarcoid lesions of the stomach have been reported in 9 other patients subjected to subtotal gastric resection, although in only 2 of these was there evidence suggestive of disseminated sarcoidosis. A histopathologic lesion resembling that of Boeck's sarcoid has also been reported in 7 patients with regional enteritis. Localized lesions associated with chronic inflammatory disease of the gastrointestinal tract, such as peptic ulcer, pyloric obstruction, regional enteritis, and Whipple's disease, and their draining lymph nodes may develop the histologic characteristics of the hard tubercle of sarcoid. It is apparent that these nonspecific localized granulomatous reactions must be differentiated from the disease entity referred to as disseminated sarcoidosis since a variety of neoplasms may also have draining lymph nodes which show the histopathologic lesion of sarcoidosis.

In an effort to evaluate the incidence of gastrointestinal involvement in sarcoidosis, the authors have studied 21 patients with proved Boeck's sarcoid who were admitted to the Temple University Hospital in Philadelphia from the Henry Phipps Institute. The patients were investigated by means of a barium meal in all cases and small bowel enema studies in 17 of the 21 cases. In no instance was an abnormality encountered suggestive of gastrointestinal sarcoidosis.

—*Harvey N. Lippman, M.D.*

Indications for Surgery of the Upper Gastrointestinal Tract. FRANZ J. INGELFINGER and GUILLERMO C. SANCHEZ. *N. England J. M.*, 1954, 250: 445.

AMONG lesions of the upper gastrointestinal tract, peptic ulceration of the esophagus, stomach, and duodenum most frequently present the problem of whether or not to abandon further medical management in favor of surgical intervention. The authors have presented a thorough discussion of the basic principles guiding the decision in these cases as well as in the less common problems of diaphragmatic hernia, esophageal varices, cardiospasm, and gastritis.

Peptic ulcer. While the necessity for surgical intervention in cases of chronic advanced pyloric obstruction is fairly obvious, the need for surgical treatment in less advanced cases is often not apparent. The primary reason for this lies in the failure to diagnose accurately whether partial pyloric obstruction exists. The "intractability" of many cases of peptic ulcer is probably related to this inaccuracy of diagnosis. The inability to demonstrate gastric retention with the barium meal may not always necessarily represent an accurate index of pyloric patency inasmuch as the amount of barium retained in the stomach is directly due to the gastric tone and motor power as well as the size of the pyloric canal.

The major criterion for operation in cases of acute hemorrhage from peptic ulcer—the rate of bleeding—is the most difficult to evaluate. Two factors upon which one may base judgment are the amount of transfused blood necessary to keep the patient out of shock and the direct observation of gastrointestinal blood loss. If more than 1,500 c.c. of whole blood is required per 24 hour period to prevent the symptoms and signs of shock, a rapid rate of blood loss may be assumed. The observation of repeated frank hematemesis is of obvious significance. Less important, however, are the signs of blood loss implied by the character of the stools. The location of the source of bleeding is considered of such importance in the decision for or against operation that early roentgenographic or endoscopic evaluation is urgently recommended.

The identification of a gastric ulcer is considered a strong indication for immediate operation and, conversely, failure to demonstrate the responsible lesion by these techniques should be a strong deterrent to the surgeon.

Intractability as an indication for operation is subject to many interpretations. In general, however, its cause is strengthened by a past history of acute perforation, episodes of vomiting, and roentgenologic evidence of a severely deformed pylorus and duodenal bulb. The latter features suggest that low grade pyloric obstruction complicates the clinical picture and is the major cause of the failure to respond to medical management.

While the treatment for acute perforation is primarily surgical, the authors concede that the decision must be made individually for each case. In general, after 48 hours conservative management is considered to be the better course.

The question of the surgical management of gastric ulcer remains highly controversial. It is agreed, however, that if the differentiation between a benign and malignant gastric ulcer cannot be made clinically immediate operation is indicated. Although the authors recognize that 10 to 15 per cent of surgically treated gastric ulcerations which appear benign roentgenologically are actually malignant, they suggest that random choice in differentiating malignant and benign ulcers can be improved upon by the application of certain other clinical criteria in the management of the individual case.

The younger the patient, the more justified one is in attempting medical therapy, especially if the patient is a woman. Ulcers along the greater curvature, although not invariably carcinoma, should still be considered a strong indication for operation. Prepyloric lesions which appear benign roentgenologically are not now thought more likely to be malignant than ulcers found elsewhere in the stomach; this represents a divergence from commonly accepted opinion. Deep, penetrating lesions along the lesser curvature are usually benign, whereas flat, plaquelike defects are more suggestive of neoplasm. The size of an ulcer is not thought to be of significance. The existence of an associated active duodenal ulcer crater is considered strong evidence against the possibility that a gastric ulcer is malignant. Although recurrence of an ulcer cannot be taken as evidence for or against malignancy, the authors emphasize the point that such lesions should be viewed with suspicion, particularly in males. The failure of a gastric lesion to heal under intensive medical therapy is often used as an indication for operation. The value of this criterion, as of all others, depends upon its interpretation. Many large ulcers, including those that are benign, do not disappear in 3 weeks. The authors suggest that should the ulcer be at least 50 per cent smaller at the end of 3 weeks, another 3 week interval be allowed for it to disappear before advising surgical intervention.

Gastritis. If serious hemorrhage is associated with localized or diffuse gastritis, partial or even total gastrectomy may be indicated. Giant hypertrophic gastritis does not warrant operation unless hemorrhage supervenes, symptoms are uncontrollable, or changing roentgenologic or gastroscopic characteristics suggest an increasing possibility of neoplasia.

Polyps. The demonstration of a polyp in the esophagus, stomach, or duodenum is an indication for operation.

Cardiospasm. The management of this particular disturbance is primarily conservative. If and when the patient's symptoms can no longer be controlled with dilatation, the Heller procedure is at present being employed with increasing frequency, although the results are not consistently satisfactory.

Diaphragmatic hernia. Esophagitis associated with diaphragmatic hernia is an indication for surgical correction of the hernia. In all other cases of diaphragmatic hernia, surgical intervention is indicated only under exceptional circumstances. An associated duodenal ulcer increases the urgency for surgical attack. Surgical treatment is not recommended unless hiatal hernia has been unquestionably identified as the source of either intermittent esophageal obstruction, respiratory disorders, perforation, strangulation, bleeding, or severe distress not relieved by intensive medical therapy.

Diverticula. With the exception of the so-called Zenker diverticulum at the upper end of the esophagus, diverticula found elsewhere in the upper gastrointestinal tract are best managed conservatively. With rare exceptions, these lesions are usually not the basis of the patient's difficulties.

Esophageal varices. Any patient who has roentgenologically or endoscopically demonstrated esophageal or gastric varices and who has suffered at least one massive bleeding episode is a candidate for a portacaval or splenorenal shunt procedure. A clinical evaluation of such a patient may be more provocative regarding the risk of operation than a battery of laboratory tests. The patient with nonmalignant extrahepatic portal obstruction who is bleeding acutely is best managed conservatively and operated upon later when the bleeding has stopped. The cirrhotic patient who is bleeding, on the other hand, will often not respond adequately to conservative treatment. In these cases, despite the added surgical risk, direct ligation of the esophageal varices through a transthoracic approach is recommended.

—*Harvey N. Lippman, M.D.*

Oblique Splitting of the Sternum in High Gastric Surgery. HERMAN WAHREN and PAUL VIKGREN. *Acta chir. scand.*, 1954, 107: 15.

THE authors believe that oblique splitting of the lower end of the sternum, possibly with division of the diaphragm, greatly facilitates the operative procedure in high gastric surgery. Their technique is as follows:

A midline supraumbilical incision is made. The operative area is explored. The skin incision is then extended upward to about the level of the midsternum. The xiphoid process is freed and extirpated. The weak diaphragmatic crura attached to the sternum are now easily perforated with the finger, and with the same digit the posterior aspect of the sternum is isolated and the pleural sacs are pushed aside. The finger is now directed toward the left side of the sternum, and against the inserted finger the soft tissues adjoining the border of the sternum are perforated with a forceps clamp. With the aid of this forceps a Gigli saw is introduced, after which the sternum is split. A retractor is inserted into the fissure. The expansion of the operative area is now determined essentially by the tension in the diaphragm, and this muscle may be divided in order to obtain more exposure and to afford access to the lower segment of the esophagus. In suturing the sternum two wire ligatures are used. Healing has been good in all cases.

The chief operative complications are pneumothorax and injury to the internal mammary vessels.

—*Robert Turell, M.D.*

The Result of Vagotomy in the Treatment of Anastomotic Ulcer. B. W. WELLS. *Lancet*, Lond., 1954, 1: 598.

THE author has undertaken to assess the results of vagotomy when used as the sole method of treatment for anastomotic ulceration following partial gastrectomy or gastroenterostomy. One hundred twenty case reports from 8 hospitals in the London area were collected. Of these, only 39 satisfied the rigid criteria for the diagnosis of anastomotic ulceration beyond all reasonable doubt. No case was accepted in which the follow-up period since vagotomy was less than 2 years, unless there had been a recurrence before then.

The 39 cases selected were personally seen and examined by the author and evaluated as to result by assigning one of 3 grades as follows: (1) clinically free from all signs and symptoms of ulceration and no evidence of ulceration found on investigation, (2) clin-

ically suspect of recurrent ulceration, but confirmatory evidence lacking, and (3) positive evidence of recurrence.

The findings were considered in 2 groups: (1) anastomotic ulceration following partial gastrectomy, and (2) anastomotic ulceration following gastroenterostomy. In Group 1 there were 25 patients. Of these, 23 had undergone partial gastric resection for duodenal ulcer and 2 for gastric ulcer. Twenty-four of the 25 patients were male. Fifteen of the 25 patients were classified as having a grade 1 result, 7 a grade 2 result and 3 as having a grade 3 result. In Group 2, there were 14 patients, 10 of whom had definite or suspected recurrence of anastomotic ulceration following vagotomy.

The author concludes that although vagotomy is not a completely satisfactory method of treatment for anastomotic ulceration following partial gastrectomy, giving only 2 of 3 patients freedom from recurrence during a follow-up period of about 3 years, it still represents a safer procedure than a more radical gastrectomy and is worthy of trial.

On the other hand, because of the very high recurrence rate following the use of vagotomy alone in the treatment of anastomotic ulcer occurring after gastroenterostomy, the author feels that this procedure has no place in the management of these cases.

—*Harvey N. Lippman, M.D.*

Experiences with Total Abdominal Gastrectomy and Substitute Stomachs (Erfahrungen mit totaler abdominaler Gastrektomie und Ersatzmagen). J. Dziadek. *Chirurg*, 1954, 25: 170.

In a series of 100 patients operated upon within the last 4 years for cancer of the stomach, total gastrectomy was performed as an urgent necessity in 30 cases (19 males and 11 females), the oldest patient being 72 years of age, and the youngest 41 years. In addition to removal of the stomach in these cases, the greater omentum, the hepatogastric ligament, and the gastrocolic ligaments with the regional lymph glands were also removed; and in 5 of the patients the tail of the pancreas (including the spleen in 3) was removed. In 1 case the left lobe of the liver had to be removed. Three of the patients had already been operated upon for ulcer in previous years, with establishment of a gastroenteroanastomosis which now had to be removed. Partial resection of the pancreas increases the operative mortality. In these cases pressure must be carefully avoided in order to reduce the incidence of postoperative traumatic pancreatic necrosis and autolytic peritonitis.

Six of the patients subjected to total gastrectomy died, an operative mortality of 19 per cent. Causes of death were: insufficiency of the sutures in 1 case, mediastinitis in 1 case, acute cardiac failure in 2 cases, and autolytic peritonitis on the fifth and eighth postoperative day in 2 cases. Among those who survived the operation, the period of survival was ¼ of a year in 2 cases, ½ a year in 3 cases, ¾ of a year in 2 cases, 1¼ years in 2 cases, 1½ years in 1 case, 1¾ years in 2 cases, 2 years in 1 case, and 3 years in 1 case. The causes of death in these 14 patients were metastases in the liver, pancreas, and lungs, and (in 1 case) in the brain.

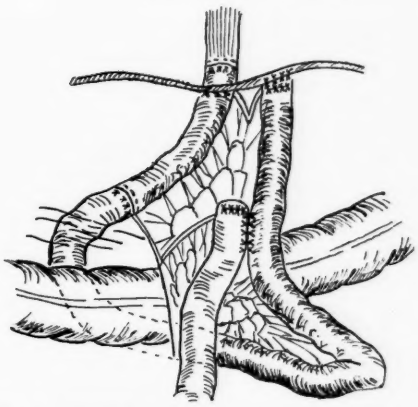

Fig. 1 (Dziadek). Condition at end of operation creating an artificial stomach. Braun's anastomosis. Afferent jejunum attached to diaphragm.

Although these results may not appear encouraging at first sight, the fact that the operations were most urgent and survival without such operation was hardly possible, would seem to justify the measure, as some of the patients lived as long as 4 years.

The majority of gastrectomized patients complain of subjective symptoms such as fullness, weariness, weakness, headaches, palpitation, nausea and vertigo. Some can tolerate only cold or lukewarm food; others are plagued with two or three soft, pale stools daily, resembling those of putrefaction or fermentation dyspepsia without tenesmus or other symptoms. Collectively, this syndrome is known as the "dumping syndrome." None of the theories offered as an explanation of this syndrome have been satisfactory, but all authorities agree that accelerated evacuation is one of the most important features.

The present author has therefore tried to prevent this accelerated evacuation by construction of an artificial stomach. The latter does not seriously prolong or complicate the operation, and the retention of food in the upper sections of the intestine is prolonged. It provides a safe connection between the esophagus and the jejunum, the safety of the anastomosis depending upon accurate suture, good blood supply and nutrition, and avoidance of any tension on the anastomosis.

The technique of the operation is described in detail. The patient is placed in the dorsal position and a lordotic curvature of the lower thoracic spine is achieved by interposition of an inflated air cushion. A left paramedian incision is made through the ensiform process to below the umbilicus. If necessary, the ensiform process is removed.

After opening the abdomen and making sure that the tumor is operable, the greater omentum is separated from the transverse colon and all enlarged glands on the major side are removed to below the pylorus. The right gastric artery is then ligated and the large glands on the minor side are removed to the cardia. The duodenum is sutured with Petz' su-

ture apparatus beneath the pylorus and divided between two rows of clamps. The gastric stump is covered with a compress and turned upward. The duodenal stump is covered with a rubber sac and left alone for the time being. If metastases are present in the tail of the pancreas or in the spleen, these are removed. The left gastric veins and arteries are then ligated and all enlarged lymph glands in the region of the cardia are removed. Special care must be exercised not to ligate the splenic artery lest necrosis of the tail of the pancreas ensue.

The triangular hepatic ligament is then divided and the left lobe of the liver is covered with a moist compress and pulled to the right with a liver hook. After circumcising the peritoneal covering of the diaphragm somewhat above the cardia on the anterior and posterior aspects, and division of the two vagus branches, the esophagus can be liberated bluntly from the hiatus and drawn out 6 to 8 cm. The hiatus is then widened until the anastomosis can easily be passed upward through the retracting esophagus into the posterior inferior mediastinum.

An upper jejunal loop with a long mesentery is then exteriorized. About 50 cm. aboral from Treitz' ligament the mesentery is detached for a length of 5 to 6 cm. The middle of the skeletalized intestine is overcast with the Petz suture apparatus and divided. The afferent end is closed with Lembert's buried sutures, leaving the ends long and caught in a clamp; the efferent end is anastomosed end-to-end with the esophagus. After traction is removed, the anastomosis lies in the posterior inferior mediastinum above the diaphragm. The anterior wall of the jejunum is fixed to the diaphragm with a few sutures.

The loop of small intestine anastomosing with the esophagus is liberated 25 cm. aboral from the mesentery, sutured with the suture apparatus, and divided. The efferent stump of the small intestine is finally closed with Lembert sutures. A terminoterminal anastomosis is made between the aboral end of the interpolated loop of small intestine and the duodenum (Fig. 1). The posterior and anterior seroserosa sutures are done as quilt (Hallstedt) sutures with silk. The clamps on the two intestinal limbs are removed and a posterior, internal, three-layer suture is introduced with catgut button sutures. Single inwardly knotted catgut sutures are used for the anterior triple layer suture. A Braun's anastomosis is then placed between the blindly closed afferent and efferent loops of small intestine above the duodenal flexure. After shortening the sutures, the afferent blindly closed loop of small intestine is fixed to the diaphragm, to the left of the hiatus. The abdominal cavity is adequately drained and following instillation of penicillin-streptomycin-marbadal solution according to Zenker, the abdominal wall is closed in 3 layers.

The indwelling tube for rapid postoperative feeding, recommended by English and American authors, is not used.

On the first postoperative day, a teaspoonful of black tea with streptomycin is permitted, and on the third day a thin gruel and jejunal feeding, according to Henning. If no complications develop, the patient is allowed to be up on the sixth or seventh day after operation.

X-ray transilluminations in such cases show that the loop of small intestine is dilated below the esophagojejunostomy in the shape of a small stomach. The duodenum and the duodenojejunal flexure are dilated. Within a few seconds contrast medium fills the dilated duodenum down to the Braun's anastomosis. After a short time the first two or three spurts of barium meal pass through the Braun's anastomosis into the efferent loop of the small intestine. A rapid peristalsis then begins and the barium meal is forced upward into the afferent loop of small intestine fastened to the diaphragm. At this level the barium can be demonstrated for quite some time, but finally passes through the Braun's anastomosis into the efferent loop of the small intestine.

X-ray studies have shown that the contrast medium remains in the "new" stomach up to 2 hours.

In this way the accelerated evacuation responsible for the dumping syndrome is avoided. After 4 to 5 weeks a gain in weight of 2 to 3 kgm. takes place. The blood sugar curves in these patients deviate insignificantly from those in normal subjects and patients who have been subjected to a two-thirds gastrectomy. With these results it would seem justifiable to increase the indications for total gastrectomy above 30 per cent. The survival of patients with gastric cancer can thus be prolonged. —*Edith Schanche Moore*

Intestinal Obstruction in the Newborn. Review of 32 Consecutive Cases. VALENTINE A. J. SWAIN and N. E. FRANCE. *Lancet.*, Lond., 1954, 1: 844.

THIS article points out the comparatively recent improvement in the outlook for the newborn with intestinal obstruction. Thirty-two consecutive cases of intestinal obstruction giving rise to symptoms in the first 4 weeks of life are reviewed.

Intestinal obstruction is characterized by vomiting, abdominal distention, and constipation which vary with the nature, site, and degree of the obstruction. Only in a small proportion of cases is vomiting due to intestinal obstruction in the newborn and it is important that in these an early diagnosis be made. Vomiting may occur, for instance, in mismanagement of feeding, stenosis or spasm of the pylorus, hiatus hernia, neonatal infections, and uremia. In complete obstruction the symptoms are usually more troublesome and persistent than they are in incomplete obstruction in which they may vary from day to day. Fullness of the abdomen at birth suggests intestinal obstruction arising in utero, but may also be found in such conditions as fetal ascites, dilatation of the bladder, polycystic disease affecting the kidneys or liver, and abdominal tumors. In meconium peritonitis the abdomen is sometimes distended at birth and, in addition, the usual signs of obstruction are present. In neglected cases of imperforate anus, the abdomen is soft at birth but becomes increasingly distended later. The infrequent passage of scanty stools, if accompanied by increasing abdominal distention, suggests obstruction. If the meconium is pale and puttylike, there may be a deficiency of pancreatic enzyme in the lower intestine caused either by complete obstruction or by cystic fibrosis of the pancreas with meconium ileus, and in the latter case, the ileocecal region is plugged by inspissated waxy material and the colon distal to the plug is us-

ually empty or contracted. The absence of trypsin from the duodenal juice when intubation is feasible, and from the meconium will confirm the diagnosis. The obstructive symptoms and signs of meconium ileus are difficult to distinguish from ileal atresia, in which the meconium below the obstruction is of a similar nature, and the presence of trypsin in the duodenum is therefore significant. The findings of amniotic squamae in the meconium will exclude the presence of complete atresia.

Roentgenologic examination assumes an important place in the diagnosis, and the simple flat plate of the abdomen is invaluable. The author states that no special preparation should precede the examination because previous stomach or bowel washings may give a false impression of fluid and gas shadows. The pattern of a distended duodenum alone suggests duodenal occlusion, while dilatation of the small or large bowel indicates the level of obstruction. If the cecum is seen in its normal position, malrotation of the colon can be excluded; free gas in the peritoneal cavity may result from a perforation of the bowel; intra-abdominal calcification is commonly present in meconium peritonitis, or displacement of the intestine by an encysted mass may be seen. A barium meal or enema is unnecessary in most cases, and in Hirschsprung's disease a barium enema in the first few weeks is of doubtful value in the diagnosis.

When the diagnosis is established, operation as soon as possible offers the best results. However, neonatal obstruction often occurs in premature infants, for whom the risk of operation is serious. But it should be borne in mind that unrelieved complete obstruction will inevitably result in death. In cases of incomplete obstruction, conservative treatment should not be prolonged if the response is poor or the baby's condition begins to deteriorate.

In most cases correction and replacement of the fluid and electrolyte loss is necessary and should be undertaken with mathematical precision.

The operative treatment for most conditions causing neonatal obstruction is on well recognized surgical lines, but there are a few in which the treatment is not so uniform:

In duodenal obstruction due to atresia, duodenojejunostomy is the procedure of choice. Extrinsic duodenal occlusion is relieved by division of the peritoneal bands across the duodenum, after the associated volvulus is corrected. In occlusion of the jejunum or ileum, resection followed by anastomosis in continuity is the ideal operation. As complete obstruction is often multiple, the patency of the intestine should always be tested by the injection of saline solution.

In meconium ileus the results are poor, largely because of the viscid nature of the meconium and the inability of the lower bowel to regain its function after operation. When obstruction is present, resection and anastomosis, in continuity when possible, is preferable to an external ileostomy. Opening of the bowel with removal of the sticky meconium by saline irrigation, followed by simple closure of the enterotomy, has been suggested. Regardless of the procedure used, pancreatin given either locally or by mouth is necessary. It is pointed out that some cases of meconium ileus, if diagnosed early, respond to conservative measures alone. After recovery from operation, babies with cystic fibrosis of the pancreas are treated with a high protein, high vitamin, high caloric diet, in addition to pancreatin by mouth. Should respiratory infection supervene, chemotherapy is necessary.

Meconium peritonitis is usually fatal, but operation now holds some hope for recovery. When a large collection of meconium is present in the abdomen, preliminary paracentesis will decompress the abdomen and the fluid can be tested for the presence of trypsin; the abdomen is then explored and any perforation of the bowel is closed by fine suturing. Obstruction in these cases is preferably treated by resection of the affected area.

In Hirschsprung's disease treatment consists in relieving the obstruction and establishing regular bowel movements by the aid of enemas and laxatives until such time as the child is old enough to stand removal of the narrowed segment by rectosigmoidectomy. The author considers it safer to wait until the child is 2 years of age. In cases in which the obstruction cannot be overcome by simple measures, immediate operation is necessary. In these cases the small and large bowel are distended with narrowing usually in the descending or pelvic colon where an accumulation of firm meconium is held up. By squeezing this meconium down into the rectum and passing a rectal tube, the obstruction can usually be relieved. When the lower segment is too narrow for this to succeed, a colostomy is made. If the newborn child survives this stage, constant supervision is required to guard against recurrence of the obstruction, and laxatives and regular saline enemas are given.

The author's cases illustrate the diagnosis and management of the various entities producing intestinal obstruction in the newborn and point out the changes in treatment that have occurred, with the elucidation of such clinical entities as fibrocystic disease of the pancreas, meconium ileus, meconium peritonitis, and Hirschsprung's disease. Although the present mortality of obstruction in the first few weeks is more than 75 per cent, the authors believe that this high figure can be reduced. —*Frederick C. Hoebel, M.D.*

Colon Obstruction Caused by Gallstones. P. Holm-Nielsen and P. Linnet-Jepsen. *Acta chir., scand.*, 1954, 107: 31.

In most reports on gallstone ileus, it is claimed that if a biliary concretion has traversed the ileocecal valve, it will continue its course through the colon and be passed spontaneously by the rectum without producing symptoms, and that, accordingly, fistulous communications between the biliary passages and the colon will not be complicated by gallstone ileus. Nevertheless, the authors have collected from the literature 25 cases of colon obstruction due to gallstones and add to these 1 case from their own experience. Considering that gallstone ileus is a rare condition, this is actually a considerable number. It must be presumed that the incidence of colon obstruction from gallstones ranges from 3 to 5 per cent of all cases of gallstone ileus.

Like other forms of gallstone ileus, this variety occurs principally in women of advanced age with a past history of biliary colic. In the majority of instances, the stone gains entrance to the bowel through

a cholecystoduodenal fistula and thus passes the entire length of the small intestine before it finally becomes impacted in the colon, most frequently in the sigmoid.

Obviously, in these cases of colon obstruction the stones did not pass the small intestine without producing symptoms. On the contrary, all the cases showed evidence of typical intermittent intestinal obstruction, often of many days' duration, caused by the repeated arrest of the concretion due to local spasms of the intestine. Visible postmortem evidence of this course of events was present in the authors' patient, in whom the ileum showed necrotic ulcerations in two places where the intestinal wall was very thin, and in one of these perforation had occurred.

In several of the cases reported in the literature, the colon showed pathological conditions at the site of the obstruction, which may be presumed to have been contributory factors in arresting the stone, but in many cases it was emphasized in the reports that the stones had become impacted in normal intestines. In the authors' own case, in which there was an acute, intense sigmoiditis at the site of obstruction, it must be presumed that the inflammatory process in the intestinal wall was of a secondary nature, and had arisen from the deep, band-shaped ulceration in the wall at the site where the stones had been incarcerated. Thus, there were no diverticula which might account for the inflammation.

It is commonly stated that the size of the gallstones plays a role in the production of gallstone ileus. Two of the largest ileus-producing stones removed at operation had thus become impacted in the colon. However, the intestinal spasm around the concretion is undoubtedly an essential factor in the development of intestinal obstruction, and such a spasm may very well occlude the bowel around a stone which is not, in itself, large enough to block its lumen. Although the size of the stone is of importance in the production of ileus, it may, nevertheless, be claimed that under favorable conditions even large stones may be passed spontaneously, and that small stones under unfavorable conditions may give rise to ileus.

The clinical picture of colon obstruction from gallstone is often even more confusing than that of other forms of gallstone ileus. Because of the low site of obstruction, the course becomes more protracted. Vomiting occurs at a later stage, but is then much more serious as it is a manifestation of a far advanced intestinal obstruction. Considerable meteorism, which is otherwise unusual in gallstone ileus, is very often present. The intermittent course, in which a pronounced intestinal obstruction may be superseded by a period with complete absence of symptoms and with passage of both flatus and feces, may easily delude the surgeon into misinterpreting the condition as a subacute form of obstruction and taking an expectant attitude with delay which may prove fatal. The only way in which to improve the prognosis of gallstone ileus is the earliest possible recognition of the nature of the condition, followed by prompt operation.

At operation, the attempt must be made to remove the obstructing stone. In some of the cases of colon obstruction reported in the literature, this was done by pushing the stone onward into the rectum, from which it was removed by a finger passed through the anus. If this procedure is possible without too much manipulation it may be justifiable; otherwise, enterotomy must be performed.

On the other hand, it is the authors' opinion that the material presented shows indisputably that in the most common variety of gallstone ileus, i.e., of the small intestine, manipulative methods by which the stone is pushed from the ileum into the colon and left there must be considered inadequate. As long as the stone has not been definitely removed, a recurrence of obstruction in the colon is still possible.

—*Matthew H. Evoy, M.D.*

Chronic Ulcerative Colitis, a Method of Ileorectal Anastomosis. E. E. DUNLOP. *Austral. N. Zealand J. Surg.*, 1954, 23: 184.

THE author's method of ileorectal anastomosis is essentially an anastomosis of the ileum to the lower portion of the rectum following the excision of the colon and the major part of the rectum. Safety has dictated temporary defunctioning of the bowel in the vicinity of the anastomosis by a proximal ileostomy. This permits the ileostomy content to thicken and the ileum to take over some storage function before alimentary continuity is restored.

The author believes that if the rectal disease is not too gross an attempt may be made to conserve normal bowel habit. An ileostomy is necessary for the time being and may be advisable always. The patient will, however, have the opportunity to weigh the discomforts of ileostomy against those of the disease and, in the event of failure, either to retain the ileostomy or have it re-established. In view of the fact that there are some patients who, despite the gravity of their disease, will not accept a permanent ileostomy as an initial, irrevocable measure, the author deems it wise to give some attention to measures designed to conserve intestinal continuity in this disease.

When there is gross rectal disease, such as perirectal suppuration, fistulas, stricture, pseudopolyps, or any suspicion of cancer, no conservative approach should be countenanced.

The abstractor maintains reservations about the long range prospects of this surgical procedure.

—*Robert Turell, M.D.*

Lymph Node Metastases: Experience with Aortic Ligation of the Inferior Mesentery Artery in Cancer of the Rectum. JACK W. MCELWAIN, HARRY E. BACON, and HOWARD D. TRIMPI. *Surgery*, 1954, 35: 513.

EXTENDED surgical procedures on the colon, rectum, and anus frequently involve the ligation of large supplying vessels. There is little disagreement as to the safety of this course of action when large branches of the superior mesenteric artery are ligated, but some controversy still exists regarding the advisability of ligating the inferior mesenteric artery above its left colic branch when an attempt is being made to preserve the blood supply to the distal large bowel.

The purpose of the authors is to report the results found after the clearing of intramesenteric lymph nodes from 90 cases of cancer of the colon, rectum, and anus in which a ligation of the inferior mesenteric artery was performed at its aortic origin.

Sixty per cent of these cases revealed positive lymph nodes, of which 17.8 per cent were located at the origin of the inferior mesenteric artery. Three cases of squamous cell carcinoma of the anus failed to exhibit nodal metastases, but the malignant mesenchymoma of the low rectum involved a regional node. All the rectal lesions initiated an orderly pattern of lymphatic spread, but the sigmoidal lesions in at least 2 cases revealed a skip pattern. No correlation was attempted between the presence of high positive nodes and lateral lymphatic spread. In at least 8 cases, ligation of the inferior mesenteric artery below the left colic branch would not have removed positive nodes in the upper portion of the mesentery. Thus, 9 per cent of the operative procedures would have been failures without high ligation.

Therefore, the authors suggest that ligation of the inferior mesenteric artery at its aortic origin in the treatment of cancer of the distal colon, rectum, and anus appears to be a safe procedure; that the presence of positive inferior mesenteric lymph nodes in cancers of the distal colon, rectum, and anus is frequent; and that ligation of the inferior mesenteric artery at its origin should be included in the extirpation of all cancers of the distal colon and rectum.

—Benjamin Goldman, M.D.

LIVER, GALLBLADDER, PANCREAS, AND SPLEEN

The Terminal Portion of the Common Bile Duct and of the Pancreatic Duct of Wirsung. E. S. R. Hughes and R. H. Kernutt. *Austral. N. Zealand J. Surg.*, 1954, 23: 223.

The terminal portions of the common bile duct and pancreatic duct of Wirsung were dissected in 30 formalin-hardened specimens. Observations were also made on some specimens while still fresh. The common bile duct approached the duodenum obliquely in 26 cases; in 7 of these the duct was separated from the duodenum by pancreatic tissue throughout the whole of its length, while in 19 it came into intimate relation with the duodenum for a length of 10 to 15 mm., just prior to its junction with the pancreatic duct of Wirsung. In 4 cases the common bile duct was closely related to the duodenum throughout the whole of its length.

As it approached the duodenum, the pancreatic duct pursued a course roughly parallel to the common bile duct and lay a little deeper in the pancreas. The two ducts joined 2 mm. to 10 mm. outside the duodenal wall and became enveloped in a common adventitial sheath. The lumina of the ducts did not become confluent at this level, but for a varying distance they were separated by a thin V-shaped septum. This septum completely separated the two ducts in all instances and in some cases actually projected beyond the papilla. In the 19 other cases the septum was shorter so that a common channel existed. The septum was often incomplete at its distal end, and the variation in published observations on the presence or absence of a common channel may be due to recognition or otherwise of the incompleteness of the septum. The length of the common channel when present was usually less than 5 mm. The combined intramural ducts formed an indurated cord which varied from 6 to 25 mm. in length and averaged 6.3 mm. in diameter.

The lumen of both ducts showed an abrupt narrowing at the level at which the walls of the ducts became contiguous just outside the duodenum. The common bile duct narrowed abruptly from an average diameter of 8.5 mm. to a slitlike channel and this often resulted in a shallow pocket in the common bile duct at this level, and related to the duodenum in 16 cases. The major duodenal papilla was always present. In no case did the common bile duct and pancreatic duct of Wirsung possess separate papillae. A minor duodenal papilla was visible for the pancreatic duct of Santorini in 27 of the 30 specimens.

In 7 of the 30 specimens a diverticulum of the duodenum was related to the major duodenal papilla. This has been referred to in the past as a "perivaterian diverticulum." In 2 other cases duodenal diverticula were present, but not in relation to the major duodenal papilla.

Gallstones in the common bile duct are most commonly found just proximal to the narrow intramural portion and are apparently able to remain here for long periods without ill effect. If the stone enters the intramural portion it may obstruct the pancreatic duct by pressure on the thin V-shaped papillary septum. Pancreatic duct obstruction appears more likely to be a factor in pancreatitis than reflux up the duct.

An operative diagnosis of fibrosis of the sphincter of Oddi must be accepted with caution. Functional disorders of the sphincter are more likely to affect the common bile duct than the pancreatic duct.

—Earl O. Latimer, M.D.

The Fallibility of Pancreatic Biopsy. Lemuel Bowden. *Ann. Surg.*, 1954, 139: 403.

Biopsy of masses in the head of the pancreas are unsatisfactory not only because of troublesome bleeding and the danger of pancreatic fistula but also because they are often noninformative and sometimes frankly erroneous. The authors review the work of others and present data of their own to show that pancreatic cancer is associated with varying degrees of pancreatitis. The ducts become invaded and obstructed, with distention and inflammation resulting in necrosis and fibrosis of the pancreatic tissue distal to the obstruction. "This distal pancreatitis surrounds the cancer to a varying degree, but necessarily forms the outermost layer of the gross tumefaction, which is the portion accessible to the surgeon's palpating hand or biopsy knife." Many falsely negative biopsies result.

The authors present 31 cases of cancer of the pancreas, in 9 of which previous negative biopsies had been made. On re-exploration, 7 of the patients had advanced cancer not amenable to excision, and the remaining 2 were subjected to resection but died of cancer later. Three additional patients were subjected to pancreatoduodenectomy for suspected cancer; the condition turned out to be benign on postoperative examination of the specimens. Fraser has shown that 7 per cent of a larger series were benign but mistakenly considered malignant, whereas 16 per cent of the

malignant lesions were considered benign. In the author's small series the percentages were 8.8 and 26.5. Since increasing numbers of 5 year cures of cancer of the pancreas are being reported, and since the surgical mortality is being reduced, the chances of having cancer underlying what appears to be a benign lesion tend to overshadow the danger of mortality from radical surgery.

The author concludes that pancreatoduodenectomy should be undertaken when on exploration one finds a tumefaction of unknown nature in the head of the pancreas that is technically resectable. This decision should not be influenced by biopsy, which he considers superfluous.

—*Victor M. Bernhard, M.D.*

Management of Pancreatic Cysts and Pancreatic Lithiasis. CHARLES B. PUESTOW and WILLIAM J. GILLESBY. *Am. Surgeon*, 1954, 20: 355.

LATE disorders arising from chronic relapsing pancreatitis include pancreatic cysts and calcifications of the pancreas. Chronic pancreatitis characteristically is a disease of alcoholic addicts of lower social strata. It is believed that beverages adulterated with methanol may be a factor in that incidence.

Pancreatic cysts are pseudocysts, lined by adventitial structures and contiguous organs, and are filled with pancreatic juices and varying amounts of blood or tissue debris. In general, external marsupialization operations should be avoided because fistulas may form and not heal. Marsupialization may not be avoidable, however, if severe infection exists. Excision of the cysts may require the resection of contiguous organs (spleen), and usually leaves a bare, secreting pancreatic surface.

Cysts in the tail of the pancreas are best anastomosed to the stomach (4 cases) or small bowel. Cysts of the body of the pancreas are best drained by a loop of jejunum utilized according to the Roux-en-Y principle. Cysts of the head of the pancreas may be managed by cystoduodenostomy. In 1 patient with an associated duodenal ulcer a gastric resection with gastrojejunostomy, a cystoduodenostomy using the end of the duodenum, and a cholecystoduodenostomy together effectively drained the cyst. However, the pain of chronic pancreatitis was not relieved until a left splanchnicectomy was performed.

Calcification in chronic pancreatitis is not necessarily pancreatic intraductal lithiasis. For the most part the calcification occurs in the previously necrotic and saponified parts of the pancreatic parenchyma. In all of the presently described cases only 1 case of duct stone was found, in which cure was obtained by lithectomy.

Partial pancreatectomy is the most effective means of treating extensive chronic pancreatitis, when the gland has been burned out. Probably it should be performed earlier in the disease before the psychiatric and drug addiction complications arise.

Intractable pain is managed as follows: The first procedure is long term biliary drainage by choledochostomy with a T-tube. Sphincterotomy, transsphincteric long T-tubes, and choledochoenterostomy are not recommended. If the latter is performed, it should be accompanied by partial gastrectomy to lessen the risk of duodenal ulceration by unneutralized gastric juices. If pain is not relieved by choledochostomy, the pain pathways are determined and lateralized by epidural or splanchnic nerve blocks. If relief is obtained by these methods, a transthoracic sympathectomy through the eighth rib bed is performed to remove the lower 8 thoracic, and the first lumbar ganglia and the splanchnic nerve. Residual pain may be relieved by a contralateral symmetrical sympathectomy. Pancreatectomy or unilateral cordotomy is the last (in order) procedure to employ for the relief of pain.

—*Leonard D. Rosenman, M.D.*

GYNECOLOGY

UTERUS

Late Urinary System Complications Following Radical Hysterectomy for Carcinoma of the Cervix. W. NORMAN THORNTON, JR. *Am. J. Obst. Gyn.*, 1954, 67: 867.

THIS study is a report of late urological complications in a group of 33 patients with carcinoma of the cervix treated by radical operation. The group is highly selective and consists, in general, of young patients in excellent physical condition with stage I or early stage II lesions.

Twelve patients received preoperative x-ray therapy as an adjunct to radical surgery. Radical hysterectomy with radical pelvic lymphadenectomy was carried out in all patients except one.

Urinary tract infections remain a problem in spite of the preoperative and postoperative administration of antibacterial agents. Neurological complications of the bladder are one of the most troublesome developments and in some patients the damage appears to be permanent. The author claims he has found no satisfactory treatment for a persistent hypotonic bladder.

Upper urinary tract complications may occur many months after operation. They seem to be secondary to ureteral strictures of intrinsic origin or from fibrosis of the retroperitoneal tissues involving the ureter.

The author believes that urological studies are necessary in the follow-up of these patients in order to detect these complications and to institute treatment prior to the development of renal insufficiency.

—*Ely Elliott Lazarus, M.D.*

ADNEXAL AND PERIUTERINE CONDITIONS

Histology and Function of the Ovary from the Embryonic Period to the Fertile Age. HANNES SAURAMO. *Acta obst. gyn. scand.*, 1954, 33: 3.

THE material for this study consisted of 36 pairs of ovaries from the embryonic period to puberty. These ovaries were all sectioned serially.

The ovaries of the newborn were not appreciably larger than those in the last trimester of gestation. After birth, however, macroscopically visible cysts related to the follicle system were absorbed. At the 16 cm. stage the ova frequently were pushed among the cells of the surface epithelium. The tunica albuginea was not observed until after the newborn stage. In infants from 6 months upward the albuginea was thick and distinct. The ovarian stroma was studied. In the 16 cm. stage the connective tissue extended radially from the hilus toward the surface in columns and in network fashion. In the 19 cm. fetus there was an increased development of these fibers, and the ova were separated from each other. In the 30 cm. stage the cortex, for the first time, could be clearly distinguished from the medulla. In the 0.8 cm. embryo there were some genital cells or oogonia. In the ovaries of the 6 month old subject, primordial ova could no longer be detected. There were only primordial follicles in the cortex. It is the author's opinion that the cells of the follicle epithelium quite obviously develop from the stroma cells, and he states that the development of the ova proceeds from the surface toward the hilus.

In discussing pathological phenomena, he states that the surface epithelium has no tendency to form cysts before puberty. Islands of squamous epithelium were not observed before puberty, and the ovulation sclerosis occurring after the menarche is entirely a physiological phenomenon although elastoid hyaline degeneration is considered. Adrenocortical tissue was seen relatively often in the area of the hilus of the ovary. Areas of primitive adrenal cortex are seen very early in embryonic development of the ovary. From the very beginning of the fetal period (4 to 16 cm. fetus) the invasion of the ovary by blood vessels and connective tissue from the hilus becomes increasingly distinct. An ovarian rate was always present and it was distinct by the second month, but from this age to puberty it became quite weak. The author regards all cystic formations in the ovaries during this period as physiological follicle atresia.—*Henry C. Falk, M.D.*

Occurrence, Function, and Pathology of Ovarian Sympathicotropic Cells, with Special Reference to Their Differentiation from Interstitial or Hilus Cells. HANNES SAURAMO. *Acta obst. gyn. scand.*, 1954, 33: 61.

VARIOUS terms have been applied to the so-called interstitial or hilus cells of the ovary. The author reviews the literature, and then presents his own observations.

There is a type of ovarian cell, occurring especially at the hilus, which appears to be closely related to the neurovegetative system, in particular the sympathetic nerves. Some authors consider these cells to be paraganglionic or chromaffin cells and term them sympathicotropic because of their location. Others identify these cells with Leydig's interstitial cells of the testis and have referred to them, because of their location, as hilus cells. The material in this study consisted of 62 pairs of ovaries from subjects varying from an 0.8 cm. embryo to an 86 year old woman. A large number of these ovaries were studied in serial sections. In the 2 cm. stage the sympathicotropic tissue had become distinct, and it was in intimate contact with cells of the adrenal cortex. At the 11 cm. stage, two islands of adrenal cortex were seen; outside of these islands some nerve appeared and near it were sympathicotropic cells. One must remember that the cortex of the adrenal gland develops first, and the sympathicotropic medulla later, and that the corresponding order in the appearance of the extraovarian adrenocortical cells and the paraneural sympathicotropic cells was noted. In a 6 month fetus a small number of paraneural sympathicotropic cells were observed at the hilus, but from this age to puberty no distinct sympathicotropic cells were found. These sympathicotropic cells were present chiefly in the fetal period, rarely during childhood. In adults during the fertile period they occurred

in small numbers in 50 per cent of normal individuals. During pregnancy they were more numerous and in senile ovaries they appeared to some extent in 30 per cent of the individuals, but they were relatively atrophic. Interstitial cells or hilus cells may occur during the fertile period but they must be regarded rather as transformation products of stroma cells than as ontogenetic remnants.

In the author's conclusions he states that during the fetal period islands of adrenocortical tissue abound between the adrenal gland and the ovary, but in adults these islands are seldom found near the ovary. In regard to the interstitial cells he believes that they are clearly related to changes and disturbances in ovarian function, and are probably of mesenchymal origin, thus derived from connective tissue cells. He does not believe that Leydig's interstitial cells of the testis are regularly and normally present in the ovaries, nor are granulosa cells and thecal cells in their different forms likely to occur regularly and normally in the testis. He believes that interstitial cells seem to appear only during the fertile period.

—Henry C. Falk, M.D.

Histology and Function of the Ovary During the Fertile Period, with Special Reference to the Effect of Pregnancy. HANNES SAURAMO. *Acta obst. gyn. scand.*, 1954, 33: 85.

THE material for this study consisted of 8 pairs of ovaries from nonpregnant subjects and 7 pairs of ovaries from pregnant subjects ranging in age from 15 to 44 years. These ovaries were studied on the basis of serial sections. The surface epithelium of the ovaries varied in appearance from cylindrical or cuboidal to quite low.

The most important observation in the ovaries of the pregnant women was the presence of growing and small graafian follicles and numerous atretic follicles. In the examination of all the ovaries, the primordial follicles were found to be numerous after the beginning of menstruation and were present in considerable numbers to the age of 30, then they seem to be decreased. Growing follicles occurred throughout the fertile period and also in pregnancy. Graafian follicles of varying sizes were also observed during the whole reproductive period and during pregnancy. In regard to the blood vessels, from the age of 28 upward, there were actual arteriosclerotic changes to be detected in the hilar arteries, intimal sclerosis, and hyalinization. Nonstriated muscular tissue was found in the hilus, and there was no extravascular nonstriated musculature in the ovarian tissue proper. Pregnancy seemed to cause the ovarian rete to become more luxuriant than during the normal fertile period. During pregnancy and the puerperium the decidual reaction invariably occurred in the superficial part of the ovarian cortex. Growing follicles were present in many of the ovaries. These evidently constitute the estrogenic system which functions less actively during pregnancy. It seems that this system forms a kind of constant basal estrogen function. The graafian follicle which ruptures, however, determines the peak of estrogenic function in the menstrual cycle. The corpus luteum of menstruation does not prevent the development of growing graafian follicles, nor does the corpus luteum of pregnancy seem to do so to any appreciable extent. The author states that in normal ovaries the increasing density of the ovarian connective tissue does not appreciably delay the rupture of follicles and so disturb the functions of the estrogenic basal apparatus; he also points out that there is thecal hyperplasia during pregnancy and the puerperium. This hyperplasia seems to be the result of hormonal factors linked up with the pregnancy. The corpus luteum of pregnancy appears to be larger than the graafian follicle from which it develops. However, from the third month of pregnancy, the connective tissue becomes increasingly prominent and is suggestive of decreasing function of the corpus luteum of pregnancy. It is emphasized that the removal of healthy ovaries for small cystic degeneration should be avoided in the presence of normal ovarian function. In studying the ovaries over the various ages, he found that the tissue structure is most perfect from the normal histological viewpoint between the ages of 15 and 30, and that changes due to wear and tear begin to appear at the end of this period.

—Henry C. Falk, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Cardiovascular Physiology in Normal Pregnancy: Studies with the Dye Dilution Technique. JOHN QUINCY ADAMS. *Am. J. Obst. Gyn.*, 1954, 67: 741.

A MODIFICATION of the dye dilution technique was employed to estimate the cardiac output and plasma volume during pregnancy. Serial determinations were made on 31 normal pregnant women at intervals of 4 to 5 weeks during pregnancy. Determinations were also made immediately following delivery and during the puerperium. Eight normal nonpregnant women served as controls. Determinations were made in the same manner as those in the normal pregnancy series.

The cardiac output during pregnancy rises rapidly from the end of the first trimester to a maximum at the twenty-eighth week of gestation. This increase amounts to 32 per cent over the nonpregnant levels. Following this peak there is a definite decrease as the pregnancy progresses. The original nonpregnant level is reached at approximately 38 to 40 weeks. Immediately following delivery there is another rapid increase in cardiac output amounting to 29 per cent. The nonpregnant levels are again reached in 2 weeks postpartum.

The plasma volume increases during normal pregnancy; however, the change is much slower than that of the volume of the cardiac output. The maximum plasma volume is attained in approximately 32 to 34 weeks of gestation. This increase amounts to 22 per cent at this point. There is no significant decrease in the plasma volume during the last trimester. The red cell volume also increases during pregnancy but to a much lesser degree. This produces a hemodilution or physiological anemia that is greatest at the point of maximum plasma volume. Therefore, the hematocrit during normal pregnancy is lowest during the thirty-second through the thirty-fourth weeks of gestation.

The circulation time was found to decrease from an average of 13.3 seconds to 11.3 seconds in 34 weeks of gestation. From this point it gradually rose, reaching 15.8 seconds in 40 weeks.

The central blood volume was found to be greater during pregnancy than in the nonpregnant state. It tends to follow the blood volume and cardiac output changes, being greatest at the point of maximum cardiac output.

The changes in the mean blood pressure and total peripheral resistance are definitely related and tend to move in the same direction. During normal pregnancy the total peripheral resistance and mean blood pressure decrease, reaching the lowest levels at the point of maximum cardiac output. This decrease is thought to be due to the enlarged maternal sinuses, the arteriovenous shunt effect of the placenta, the increased cardiac output, and to the decreased viscosity of the blood.

—Alan Rubin, M.D.

Abruptio Placentae; Dangers of Delay in Delivery. ERNEST W. PAGE, EARL B. KING, and JAMES A. MERRILL. *Obst. Gyn.*, 1954, 3: 385.

THE most severe grades of abruptio placentae are accompanied by systemic effects, some of which are potentially lethal. These include a type of shock which is frequently out of proportion to the degree of hypotension, a disseminated fibrin embolism, an in vivo defibrination of the blood leading to uncontrollable hemorrhage, an ischemia of the renal cortex, and an activation of a fibrinolytic system in the plasma. It is believed that all of these events may result from the escape of biologically active materials from the separation site into the maternal circulation. The extent to which the latter process proceeds may vary with the hydrostatic pressure within the uterus and the time which elapses between the onset of concealed hemorrhage and delivery.

The method of grading the severity of abruptio placentae should reflect the risks to fetal and to maternal life. Mortality rates, as related to modes of therapy, must be expressed individually for each grade of severity.

Three series of abruptio placentae cases are presented which illustrate the reasons for conservatism in mild grades, the value of immediate cesarean section in reducing fetal mortality in the moderate grades, and the extreme hazards of delay in delivery in the severe grades. Principles of therapy are recommended for each type of abruptio placentae.

—Alan Rubin, M.D.

The Management of Pregnancy Complicated by Heart Disease. JOHN C. ULLERY. *Am. J. Obst. Gyn.*, 1954, 67: 834.

OF 41,361, women delivered at the Pennsylvania Hospital, Philadelphia, during the years 1937 to 1952, inclusive, the total number with heart disease was found to be 565, an incidence of 1.12 per cent.

The maternal mortality rate among the pregnant cardiac patients was 2.6 per cent (15 maternal deaths), and the fetal mortality rate was 12.3 per cent (70 fetal deaths). Heart disease has occupied the most prominent position as a cause of maternity mortality, accounting for 27.2 per cent of the maternal deaths from all causes during the 16 years reviewed in this hospital. Acute congestive failure was the cause of death in 11 of the 15 deaths. Infection was the precipitating factor in 7 cases. Prematurity was the leading cause of death of the babies.

The pregnant cardiac patients were divided into two groups: those delivered from 1937 to 1947, and those delivered from 1948 to 1952. The purpose was to analyze the groups in relation to the establishment of the Cardiac-Obstetric Clinic in 1948. Only 1 maternal death from heart disease has occurred, that of an unregistered patient.

The management of pregnancy with heart disease should include the following:

1. An understanding of the physiological changes in the circulation in the normal pregnant woman and the changes in the pregnant woman with heart disease.

2. The diagnosis and assessment of the pregnant woman with heart disease.

3. Proper and adequate treatment during pregnancy, delivery, and puerperium.

The different phases of treatment are discussed in detail. Certain techniques in treatment, such as the increased use of forceps for delivery, conduction block anesthesia, and the use of digitalis therapy are emphasized. Close co-operation between the cardiologist and the obstetrician at all times is strongly advocated. —*John R. Wolff, M.D.*

Rupture of the Utero-ovarian Veins During Pregnancy and Labor. STIG SAMUELSSON. *Acta obst. gyn. scand.*, 1954, 33: 91.

RUPTURE of the utero-ovarian veins which usually become varicose even in normal pregnancy may give rise to hemorrhage endangering life. It occurs most frequently in connection with uterine rupture, but when it happens alone it constitutes a specific complication. Forty-six cases have been reported in the literature and the author adds another.

The patient was a 33 year old gravida 2, para 1. During labor which began spontaneously at term, a cushionlike area of resistance was noted in the lower part of the abdomen. Hematuria developed. A living child was delivered by midforceps. Manual placental removal was necessary because of placenta accreta. The patient suddenly died of shock during repair of the episiotomy. At autopsy a subperitoneal hematoma extending along the anterior uterine wall was found. The uterus was not ruptured nor was any site of vessel rupture discernible.

Three factors are to be considered in the etiology: trauma, increased fragility of the veins in pregnancy, and increased venous pressure. There is no characteristic symptomatology. The total mortality is about 38 per cent. Treatment should be directed to combating shock and ligating the site of rupture. A hysterectomy might well be necessary.

—*Warren R. Lang, M.D.*

The Contracted Outlet. D. FRANK KALTREIDER. *J. Am. M. Ass.*, 1954, 154: 824.

EIGHTEEN hundred thirty-one cases from the University of Maryland Hospital, Baltimore, were utilized in an attempt to discover the best means of determining outlet contraction. The material studied consisted only of vertex deliveries in which labor proceeded to full dilatation of the cervix and was terminated spontaneously by low forceps or by cesarean section for infants weighing between 2,500 and 4,000 gm.

In each instance roentgen pelvimetry had been performed. The usefulness of several criteria for the recognition of outlet contraction was appraised. The following conclusions were drawn: (1) the anteroposterior diameter of the outlet measured by means of x-rays is a better method of prognostication of difficult delivery than determining the sum of the intertuberous and posterior sagittal diameters obtained either clinically or with x-rays, (2) from a practical, clinical viewpoint, the midplane and the outlet should be considered one plane, and (3) the trial use of forceps is recommended for patients in whom there is lack of descent during the second stage of labor. If gentle traction and correction of any unfavorable presentation, such as occiput transverse or occiput posterior, does not easily consummate delivery, cesarean section is a better procedure than vaginal delivery for the sake of the infant.

—*Alan Rubin, M.D.*

LABOR AND ITS COMPLICATIONS

"Failed Forceps": a Review of 100 Cases. R. LISLE GADD. *Brit. M. J.*, 1954, 1: 735.

THE author states that 50 per cent of the "failed forceps" cases investigated at the Birmingham Maternity Hospital by Freeth in 1950 arose because of the occipitoposterior position or deep transverse arrest of the head. The maternal death rate was 2 per cent and the total fetal loss was 34 per cent. The author quotes Miller (1928) whose maternal death rate was 10 per cent and fetal loss 64 per cent.

The present study was to confirm this reduction in mortality. The material consisted of all the "failed forceps" cases admitted to St. Mary's Hospital, Manchester, England, during the period from January, 1943 to December, 1951. The most common cause of the failure was found to be an undilated cervix (39%). The maternal death rate was 2 per cent and the total fetal loss was 28 per cent.

The incidence, etiology, prophylaxis, and principles of treatment are discussed.

The author believes improved care and teaching have accounted for the decline in incidence.

—*Byford F. Heskett, M.D.*

Cesarean Sections in Denmark During the 10 Year Period from 1941 to 1950, with Special Reference to Indications and Maternal Mortality. E. BRANDSTRUP and PER SCHOU. *Acta. obst. gyn. scand.*, 1954, 33: 1.

THE authors present a report on all cesarean sections performed in Denmark during the years 1941–1950. A total of 2,488 patients were treated in 96 hospitals in this country. The all-over frequency of cesarean section increased from 1.8 per thousand in 1941 to 4.5 per thousand in 1950. Among the indications for cesarean section, placenta previa was the most frequent one, and accounted for 31 per cent. Next in order of frequency was pelvic contraction (21 per cent) and toxemia (7 per cent). Various other complications indicating the need for cesarean section, mainly to save the child, accounted for 20 per cent of the series.

The absolute frequency of cesarean section in this country during the 5 years from 1946 to 1950 has been as follows: for placenta previa, 40 per cent; for contracted pelvis, 14 per cent; and for eclampsia, 16 per cent.

The all-over maternal mortality, as well as the cesarean section mortality, has decreased during the last 10 years, the cesarean section mortality in Denmark being 9.4 per cent in 1941, and 1.9 per cent in 1950. Although the cesarean section mortality has decreased considerably, it constitutes an increasing share of the total maternal mortality.

While the average total of cesarean sections was 3 per cent during the last 5-year period, the mortality percentages among cesarean sections for the different complications are as follows: placenta previa, 3.3 per cent; pelvic contraction, 1.9 per cent; eclampsia, 11 per cent; various indications mainly in favor of the child, 2.7 per cent. As to the causes of death, paralytic ileus accounts for a quarter of the deaths, infection is given as the cause for approximately one-fifth, and pulmonary embolism for one-sixth of deaths.

At the present time the complications mentioned are very rarely seen after spontaneous deliveries; it is therefore permissible to regard these deaths, amounting to two-thirds of the total number, as being due directly to the operation. Hemorrhage, shock and eclampsia, on the other hand, are fairly frequent birth complications, and these deaths may therefore be ascribed to the primary condition in many cases.

All facts considered, it may be stated that during these 10 years, cesarean section has presumably been performed too infrequently for placenta previa, too often for eclampsia, too late for pelvic contraction, and in too many different hospitals, the number of specialized departments in Denmark being still too low.

—John R. Wolff, M.D.

Birth Injuries. Odd Morstad. *Acta obst. gyn. scand.*, 1953, 33: Supp. 1.

The general problem of birth injury is discussed. It is stressed that birth trauma should be considered from a physiological rather than from a pathologico-anatomical point of view. This report is from the University Maternity Hospital of Oslo. A considerable proportion of the patients were admitted for imminent or evident birth complications. For this reason the series does not represent "normal material," which is shown by the fact that the average infant mortality, as well as the maternal mortality, is definitely higher here than in the country as a whole.

The study covers the 20 year period from 1930 to 1949, inclusive (44,533 deliveries). The mortality was 5.17 per cent. The proportion of infant deaths due to birth injury was 44 per cent. Five per cent of the number of children discharged alive showed evidence of transient or permanent birth injury.

For the purpose of elucidating purely obstetrical problems a group of cases of asphyxia and a group of cases of cerebral hemorrhage were selected. Both groups showed an exceptionally high incidence of premature births (about 28 per cent in the cerebral hemorrhage group) as the most striking feature. The problem of premature birth involves many unknown factors. The elderly primiparas represent a definite obstetrical problem, but the "prophylaxis" with regard to this cause of birth complication is largely a social one.

Follow-up examination showed that 140 cases were followed up with questionnaires only. A further 209 cases were clinically controlled. The most frequent and severe sequelae were found in the group of infants presenting signs and symptoms of cerebral hemorrhage in the maternity ward (sequelae in about 33 per cent of the cases). However, as asphyxia has been found to be the most frequent birth injury (2.9 per cent of all births), the sequelae of this lesion (about 8 per cent of all asphyxiated infants) are numerically predominant. Estimated on the basis of the referred figures the sequelae of asphyxia appear in 0.22 per cent of all live births.

It is pointed out that all infants showing evidence of cerebral injury, even slight, should be treated as suffering from cerebral hemorrhage. Furthermore, it is recommended to segregate these infants in a separate ward under the permanent care of a trained, specialized staff.

—John R. Wolff, M.D.

NEWBORN

Fetal and Neonatal Hepatitis and Its Sequelae. J. Henry Dible, W. E. Hunt, V. W. Pugh, L. Steingold, and J. H. F. Wood. *J. Path. Bact.*, Lond., 1954, 67: 195.

The authors call attention to certain cases of severe liver disease in the newborn which can be shown not to be due to blood incompatibility, syphilis, or congenital obliteration of the bile ducts. The infants may die within 1 or 2 days of birth, and the characteristic lesions are of such a stage in development that their in utero origin is most certain. The authors consider them to be cases of intrauterine hepatitis and they speculate that if this be true, then the question of virus origin arises as in the adult. Siblings may be affected.

The acute phase, the pathological changes, and the postnatal sequelae are discussed and case reports are presented.

The authors discuss the possible viral origin of the disease and the possible relationship of the disease to juvenile cirrhosis.

—Byford F. Heskett, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Lipomatous Retroperitoneal Tumors: Urographic Findings. James N. DeWeerd. *J. Urol.*, Balt., 1954, 71: 421.

Primary lipomatous tumors in the retroperitoneal space are relatively rare, but they present a major problem in that roughly two-thirds of them are malignant liposarcomas at the onset or on recurrence. In the majority of cases in which a urographic survey is carried out, there are positive findings.

Of 50 patients who had received surgical treatment for fatty retroperitoneal tumors at the Mayo Clinic subsequent to 1910, 31 had undergone a urographic investigation. In several of the early cases only kidney, ureter, and bladder films were made. On review of the findings in 26 cases in which excretory urograms or retrograde pyelograms were made, displacement of the kidney was demonstrated in 13 cases, often associated with some degree of torsion of the kidney about one or more of its three axes. Distortion of the collecting system in association with displacement occurred 3 times. There was ureteral displacement not associated with kidney displacement in 3 instances in which the tumors were small and were situated in the retroperitoneal space more caudad than the kidney. In 2 cases soft tissue masses contiguous with the kidney, but apparently not otherwise associated, could be seen. Negative findings were recorded in 5 cases.

Four interesting representative cases are included with photographic reproductions.

—*Allan K. Swersie, M.D.*

Value of Plain Film in Renal Mass Lesions (Tumors and Cysts). Alice Ettinger and Milton Elkin. *Radiology*, 1954, 62: 372.

The authors stress the value of plain roentgenograms of the abdomen which give information about the presence of a mass lesion of the kidneys. Their material comprises 67 proved renal tumors and cysts. The findings are based on anteroposterior plain films.

Of the 67 proved renal mass lesions, 33 were malignant tumors—29 proved by operation and histologic study and 4 by evidence of metastases. There were 32 renal cysts, a hamartoma, and a benign papillary adenocystoma. Mass lesions manifested themselves either by (1) a localized bulge of the renal contour, (2) diffuse enlargement of the renal outline, or (3) calcification. Fifty of the renal mass lesions were readily seen on the plain films—48 because of contour changes and 2 because of calcification alone. Eight tumors and 9 cysts were not visualized on plain films. In only 4 cases was failure of visualization due to the position (intrarenal) of the mass itself. Roentgen visualization on plain film was highly superior to physical examination by palpation. Oblique films and tomography may be valuable for demonstration of renal contours. A definite differential diagnosis between tumor and cyst cannot be made on the basis of routine x-ray findings; in this puncture and contrast filling of the cyst, aortography, and renal artery catheterization may be helpful.

—*David Rosenbloom, M.D.*

Megaureter. F. Douglas Stephens. *Austral. N. Zealand J. Surg.*, 1954, 23: 197.

The author stated that there are cases of bilateral megaureters in which ordinary urinary investigation fails to disclose a mechanical obstruction. These cases are divided by means of cystourethrography into megaureter with, and megaureter without, vesicoureteral reflux.

Cystourethrography in the reflux group demonstrated: (1) complete emptying of the bladder and a normal urethra and bladder neck; (2) bilateral incompetence of the ureterovesical junctions permitting reflux, although not necessarily as free up one side as up the other, in the same patient; (3) a filling defect at the ureterovesical junction; (4) reflux content of the ureter, often evacuation of the bladder, was discharged quickly back into the bladder, even though unaided by gravity when the patient lay in the prone position on the table; (5) complete evacuation of the urinary system could be brought about in the cooperative child by two or three successive acts of micturition at intervals of 2 minutes (This procedure is called "triple micturition."); and (6) after periods ranging between 6 and 18 months, 2 patients showed progressive improvement in the dilatation, and the remainder showed no further increase in caliber or calyceal involvement.

The more patulous the ureteral orifice, the more free was the reflux, but apparently normal orifices also permitted reflux in these cases. The ureterovesical junction in these cases was either completely or partially incompetent.

Treatment, apart from selective chemotherapy to sterilize the urine, was attempted by (1) removal of the residual urine (obtained by triple micturition in the co-operative child); and (2) protection of the kidneys from back pressure. The kidneys were shielded from the mounting pressures of the filling bladder by encouraging frequent regular "by the clock" micturition. Over periods between 1 and 2.5 years 6 patients were treated by this regimen. Urinary infections were eliminated completely in 5, and in the sixth patient there was a short recurrence.

On micturition cystourethrography, vesicoureteral reflux was not demonstrable in the second group, but the bladder, bladder neck, and urethra were roentgenologically normal. There was no vesical residual urine. The ureteral orifices were normal or enlarged and presented no obstruction to the catheters. The ureterovesical junction was competent in all ureters. On examination of the ureters by intravenous pyelography and retrograde ureterography, there was a change in shape suggestive of peristaltic activity. In 2 untreated children observed over periods of 2 to 5 years, there was definite progression of the ureteral, pelvic, and calyceal dilatation. Obstruction at the ureterovesical junction was suspected by obliteration of the column

of iodide at or immediately proximal to the intramural course and by considerable delay in the emptying of the ureters after retrograde injections of iodide. This delay was estimated in only 2 patients, but in both it exceeded 20 minutes. Delay in emptying in the presence of peristalsis suggested an obstruction in the ureterovesical region of the megaureter without reflux.

If, after conservative surgery upon the ureterovesical junction, ureteral reflux occurs, triple micturition may help in the elimination of residual urine in the urinary tract. —*Robert Turrell, M.D.*

Ureteral Stump Giving Rise to Symptoms. B. B. Schultze. *Acta chir. scand.*, 1954, 107: 41.

In over one-third of the cases reported, in which the ureteral stump produced a postoperative complication following nephrectomy, the cause of such difficulty was a concrement which had been left; and in another third the cause was stenosis of the ureter, which rendered drainage into the bladder difficult. The remaining one-third was almost evenly divided between tuberculous ureteritis of the stump, other infection, and vesicoureteral reflux.

Recurring dysuria, frequency, and pyuria in a patient who has had nephrectomy without total ureterectomy should prompt investigation of the stump. The patient may or may not complain of lower abdominal pain or ureteral colic on the side of the previous nephrectomy, but the diagnosis must be left to cystoscopic and radiographic studies in which one may find pus making its exit from the ureteral orifice, and radiologically a calculus may be visualized as well as dilatation of the ureteral stump. Normally, the ureteral stump becomes obliterated and fibrotic. Even the tuberculous stump may heal without causing further trouble.

In the 2 cases which the author presents, surgery was required in one patient because of a calculus which was left in the lower portion of the ureteral stump, and in the other patient a stricture was the cause for subsequent intervention. It is important, therefore, that inspection of the ureteral stump at the time of nephrectomy should include careful examination for calculi or pathologic changes, especially stenosis in the lower portion of the ureter.

—*Peter L. Scardino, M.D.*

Recurrence Following Operations for Upper Urinary Tract Stone. James W. Sutherland. *Brit. J. Urol.*, 1954, 26: 22.

The reported incidence of the recurrence of stone in the upper urinary tract following operation varies within wide limits. There are obvious reasons for this variation. The most important of these is probably the thoroughness with which cases are investigated. Many recurrent calculi are symptomless and recurrence rates reported on the basis of follow-up questionnaires which fail to detect the recurrence of stone are therefore misleading; also, the length of time which has elapsed before the patient is re-examined is an important factor. A recurrent stone may be genuine or a pseudorecurrence. A portion of a stone left behind at operation would obviously yield false recurrence statistics.

The author interviewed and carefully investigated 216 patients. In this series, no case has been included in which less than 2 years have passed since the operation. Fifty-six per cent of the patients were followed for 5 years, 30 per cent were followed for more than 10 years, and 10 per cent for more than 20 years. A detailed history which included data on dietary habits, night vision, and consumption of fluids was obtained. The urine was examined bacteriologically and cytologically. A roentgenological review of the urinary tract consisted of a plain plate and of intravenous and retrograde pyelography when indicated. Blood calcium and phosphorus levels were also determined.

Despite this thorough examination of each patient, the etiology of recurrence of stone was not apparent from such a clinical study. Preoperatively the stone was present in the right kidney in 46 per cent of the cases, in the left kidney in 43 per cent, and bilaterally in 11 per cent. Fifty-four per cent of the patients were males and 46 per cent were females. The stone appeared to be more prevalent in the second, third, fourth, and fifth decades of life.

The various operative procedures for stone were as follows: nephrectomy was done in 18.7 per cent, either pyelolithotomy or nephrolithotomy in 58.3 per cent, and ureterolithotomy in 23 per cent. The recurrence of stone could be classified as mild or severe. The patients with "a mild recurrence of stone" appeared to enjoy good health and had no backache or hematuria, while those who suffered from severe recurrence either needed or had a secondary stone operation. The latter were frequently crippled by repeated bouts of colic or the passage of stones. The medium-sized stone with its liability to impaction within the ureter and to frequent bouts of colic and anuria was considered more serious than the large staghorn calculus.

The incidence of recurrence of stone following 240 operations was as follows: after 100 pyelolithotomies, the incidence was 47 per cent. Of these recurrences, 20 per cent were mild and 27 per cent were severe. Nephrolithotomy, as could be expected, produced the severest recurrence rate of all. After 40 such operations recurrence was noted in 25 (62.5%) cases, of which 10 were mild and 15 were severe. Forty-nine patients had ureterolithotomy. Recurrence of stone was detected in 18 (37%) cases, of which 14 were mild and 4 were severe. After all types of operations in the 216 patients, there were 127, or 58.8 per cent, who remained free from recurrence while 89 patients developed mild or severe recurrence (41.2%).

In the older cases several factors contributed to a high recurrence rate. These patients did not have the benefit of many of the facilities now taken for granted. Diagnostic methods were not as highly developed in those days; few patients had postoperative x-ray examination so that the incidence of pseudorecurrence was unknown; urinalysis was rarely done postoperatively and modern antibiotics were not available. Infection, therefore, often persisted for many years unchecked. The benefit of modern methods was apparent when the recurrence rates in patients operated on in the periods from 1930 to 1939 and from 1940 to 1949 were compared. There was an 11 per cent decrease in the recurrence rate in the second group. Recurrence appeared to be twice as common in males as

in females, which is difficult to account for. Contralateral recurrence occurred in 11.1 per cent after nephrectomy and in 12.3 per cent after conservative operations. The usual interval between operation and recurrence of stone was 2 years. In 89 recurrent cases, 28 per cent were detected within 2 years, 58.4 per cent within 5 years, and 87.6 per cent within 10 years after the operation. There is no correlation in the recurrence rate between single and multiple stones. Large staghorn calculi associated with chronic infection, however, are more prone to recur. It is common knowledge that infection plays a significant role in recurrence of stone. Among 125 cases, recurrence of stone occurred in 13 per cent of patients who had sterile urine and in 64.5 per cent of those who had infected urine. Hyperparathyroidism has been reported in 2 to 4 per cent of stone cases, and only one instance of this disease was found in 37 patients in whom it was investigated. The phosphate and oxalate stones are most prone to recurrence and this tendency is less with uric acid or cystine stones.

The prevention of stone recurrence is not a precise matter but each case must be carefully studied to determine what will give the best chance of cure to the patient. The best operation is that one which removes the stone completely and damages the kidney as little as possible. Partial nephrectomy to include excision of a "dysuric calyx" as advised by Twinem is still an unsettled matter. A high fluid intake, eradication of infection, elimination of stasis, and dietary management are advisable. Administration of aluminum hydroxide gel, as was suggested by Shorr, to reduce the phosphate excretion may be valuable especially if a urea-splitting infection is present.

—*S. Richard Muellner, M.D.*

BLADDER, URETHRA, AND PENIS

Double Bladder (Vesica Duplex) with Solitary Urethra in a 4 Year Old Boy; Plastic Operation with Excellent Functional and Anatomical Results (Vessie double (vesica duplex) avec urètre unique chez un garçon de 4 ans; operation plastique; excellent résultat anatomique et fonctionnel). PIERRE BOISSONNAT. *J. urol méd.*, Par., 1953, 59: 883.

ABOUT 40 cases of double bladder have been reported in the literature. There are many variations of this anomaly. In some cases the bladder may be subdivided into two cavities separated by a sagittal septum, sometimes a frontal septal separation. In other cases the bladder may be subdivided by a constriction that results in an hourglass type of bladder.

The second variety (the vesica duplex) has a complete vesical duplication. There may be two urethras; in the male there may be a double penis, and in the female, two uteri and two vaginas. A duplicate rectum is frequently associated with this type of anomaly, and it is noted that other anomalies of the genitourinary tract are found with this malformation.

Most of the authentic cases have been discovered at autopsy. In the living patient, certain types of diverticula may simulate a double bladder and may be discovered during life when the proper diagnostic procedures are used.

In the author's case, a 4 year old boy had a malposition of the kidneys and bilateral club feet, and the question arose whether there was a vesicodiverticulum or a duplicated bladder with a solitary urethra. Only after repeated attacks of epididymitis was attention drawn to the urinary tract. The diagnosis suggested by urography was confirmed by cystourography, urethrocystoscopy, and finally by surgical exploration. A simple plastic operation resulted in a cure.

The boy was hospitalized because of recurrent attacks of epididymitis. A tentative diagnosis of tuberculous epididymitis was made, and an excretory urogram demonstrated an abnormal upper urinary tract with malrotation of the renal pelvis. A diagnosis of horseshoe kidney was made. The bladder seemed to be divided into two parts, right and left. The right segment of the bladder was narrow and fusiform and seemed to be a continuation of the urethra. A picture taken during micturition showed that the two separate parts of the bladder opened into one urethra.

Cystourethrography confirmed the impression that the patient did not have the usual bladder diverticulum from which one urethra opened, but, rather, a double bladder. The x-ray pictures showed that when the bladder was distended the left part obscured the right side. It was also found that the right renal pelvis filled by reflux from the bladder.

Urethroscopic examination revealed that the cause of the recurrent epididymitis was due to the unusual location of the opening of the ejaculatory ducts in relationship to the bladder neck.

Surgical investigation showed that the two bladders arose from the same partition. The tissue between the two bladders was separated almost to the base. Extraperitonealization of the bladders was easy. The peritoneum was not adherent to the dome of the left bladder. The center medial portion of each bladder was resected down to the common base. The cut edges of each remaining section of the bladder were approximated with interrupted No. 000 catgut sutures approximating each remaining half of the bladder. A catheter was placed through the urethra for drainage. On reflecting the peritoneum, it was discovered that the patient did not have an isthmus between the two kidneys (horseshoe kidney), but rather separate malrotated kidneys.

The urethral catheter was removed on the tenth postoperative day. Six months later the child was in good health without recurrence of pyuria or epididymitis. The cystogram did not show right vesicoureteral reflux, the bladder was normal in outline, and there was no residual urine following micturition.

—*Conrad A. Kuehn, M.D.*

Mucinous Adenoma of the Urinary Bladder (Das schleimbildende Adenom der Harnblase). W. PENITSCHKA and FERD. ROTH. *Zschr. Urol.*, 1954, 47: 172.

THE authors review 18 cases of glandular and mucinous adenoma reported in the literature. They note that Paschkis distinguishes three groups of adenomas: (1) adenomas consisting of solid cell strands and cell nests; (2) adenomas consisting of solid cell strands, tubular glands, and cysts lined with transitional,

cuboid, and cylindrical epithelium (the cysts contain detritus which shows mucin reaction); (3) adenomas consisting of glands which resemble those of the rectum. The tubular glands contain goblet cells and true mucus which covers the surface of the tumor.

The adenomas are solid, lobulated, or polypoid, of lentil to walnut size, whitish or bluish-red; they are frequently seen around the orifices, either pedunculated or with a broad base.

There is a paucity of symptoms, but intermittent hematuria of long duration is characteristic; it occurs during, or at the end of micturition. Dysuria may or may not be present. Retention from occlusion of the internal vesical orifice by tumor masses may occur, though rarely.

Cystoscopic diagnosis is difficult because of the resemblance of these tumors to other neoplasms. The covering of the adenoma with mucus is characteristic and granular cystitis can be seen in the adjacent area.

The authors present the case of a 61 year old woman who suffered from intermittent hematuria for 9 months. Cystoscopically, a solid cherry-sized, pedunculated, brown tumor was seen close to the vertex. Histologic examination of the tissue removed for biopsy showed tissue resembling the rectal or colonic mucosa, with the formation of atypical glands and goblet cells. A tentative diagnosis of carcinoma was made. The tumor was excised transvesically after extraperitonealization of the bladder, and pathologic examination revealed a polypoid tumor of hazelnut size, with a broad base. Tubular glands of the type of Lieberkuehn's crypts were present, and mucus covered not only the surface, but filled the glands and cysts. Mucinous granules were found in the glandular epithelium. The marginal parts were covered by transitional epithelium arranged in papillomatous fashion; in some places cylindrical epithelium was seen. There were solid and cystic epithelial nests of von Limbeck and von Brunn. Malignancy could not be demonstrated—neither metastatic nor by extension of the process.

The authors explain the histogenesis of this tumor on the basis of the associated nodular, cystic, papillary, glandular, chronic cystitis. They believe that irritation leads to the changes which culminate eventually in the formation of cysts arising from the epithelial nests of von Limbeck and von Brunn, and also in the formation of true Lieberkuehn's crypts. The embryologic development of the bladder is largely from the cloaca (entodermal); the urinary epithelium may change into (1) a papillary fibroepithelioma or carcinoma; (2) leucoplakia, cholesteatoma, or a cornifying squamous cell carcinoma; and (3) urocystitis glandularis cystica, mucinous adenoma, or mucinous carcinoma. Metaplasia of polyvalent cells may lead to tumor. Metaplastic changes may convert the exstrophic bladder lining into mucosa resembling that of the rectum in order to prevent desiccation (Enderlen 1904). —*Ernest Bors, M.D.*

The Metastasis of Primary Epithelial Bladder Tumors (Les metastases des tumeurs epithéliales primitives de la vessie). PIERRE ABOULKER and JEAN CHOME. *J. urol. méd.*, Par., 1953, 59: 845.

OF THE tumors of the urinary tract, epitheliomas of the bladder metastasize less frequently than those of the kidney and prostate. The bladder tumor kills by causing uremia or urinary infection, but seldom by generalized carcinomatosis. The metastasis from cancer of the bladder was recognized in 1854 by Schraut.

In 1883 Geissler discovered an osseous metastasis from a vesical cancer. Hawthorne, in 1907, observed an extension to nerve tissue. Fergusson, in 1911, reported 5 cases of cardiac metastasis.

The question of osseous metastasis of these tumors was revived by Kretschmer, who reported a large number of cases. Stenius, in Germany, emphasized the importance of perivesical fat and the lymphatics in the metastasis of vesical tumors, and in later years Jewett, in particular, became interested in studying these tumors to determine their prognosis, metastasis, and their extent through various layers of the bladder.

Of 902 cases of bladder tumor collected by the Carcinoma Registry of the American Urological Association, 72 cases were associated with metastasis. Jewett reported 60 cases of metastasis among 107 tumors, while Walther presented a study of 17 cases of positive metastasis from 37 bladder tumors. The authors are not concerned with the exact percentage of metastases from vesical tumors, but describe 8 cases that were collected during the past 3 years.

The first case was that of a man 43 years of age in whom a diagnosis of epithelioma of the bladder was made when the areas of tumor were microscopically studied. A total cystectomy was done on November 17, 1949 On September 24, 1951 the patient received radiotherapy because of a right-sided tumefaction. Six months later he was hospitalized because of a sciatic type of pain in the posterior surface of the right thigh, and a weight loss of approximately 7 kgm. A tumor the size of a pigeon's egg was found on the anterior surface of the thorax. There were also small lymph node enlargements in the axilla. The patient died 2 years and 8 months after the total cystectomy. Autopsy revealed numerous cutaneous and costal tumors; however, no anatomic connection between the two structures could be found. There was no demonstrable recurrence of tumor in the vesical loge. The pre-aortic nodes were involved, but no invasion of the central nervous system was found. The authors considered the type of cutaneous metastasis found in this case to be rare, for they could find only 20 cases of cutaneous metastasis from bladder cancer reported in the literature.

This first reported case was of interest because the primary bladder tumor could be classified as Class A of Jewett, for a small amount of normal bladder tissue separated the tumor from the perivesical fat. The metastasis was slow in developing, yet it demonstrated the numerous distant organs and tissues that are susceptible to contact with this type of cancer cell, as well as the fact that the cellular differentiation varies somewhat according to the tissue involved.

The second patient was 49 years of age and had a history of cystitis, with a weight loss of 3 kgm. in 1 month. He had dysuria and hematuria on the day preceding his admittance. A cystectomy was done on June 14, 1952. On October 21, 1952 the patient developed pain in the right leg, most severe at the knee, with edema of the right leg. A large right inguinal node was found. He died on May 13, 1953. Autopsy

showed numerous pulmonary metastases in both lungs. The liver was riddled with metastases, 2 to 3 cm. in diameter. All of the pre-aortic nodes were involved. The pelvis was completely filled with neoplastic formation. The left psoas muscle was normal in size, but the right psoas was enlarged to more than 15 cm. in thickness. All of the pelvic nerves were invaded by tumor, but the central nervous system was not invaded. Three principal nodes of dissemination of the tumor had played a role in this case: (1) direct extension of the carcinoma into the pelvis, (2) dissemination via the lymphatics, and (3) metastasis by way of the blood stream to the lungs and the liver.

The third case was that of a patient 68 years of age, who had a cystectomy for epithelioma of the bladder. Autopsy showed an infiltrating vesical tumor comparable to the Group C tumors of Jewett. The pancreas was the site of an epithelial tumor similar to the one found in the bladder, but modified somewhat to the surrounding pancreatic tissue.

The fourth case was that of a woman 45 years of age who was hospitalized because of polyuria, cysturia, and hematuria. On May 12, 1952 surgical exploration was done and an attempt was made to perform a cystectomy, but this was impossible because of extensive pelvic carcinomatosis involving the rectum, vagina, and the entire pelvis. Autopsy revealed generalized involvement of the pelvis. The bladder contained a papillary tumor about 2.5 cm. in size, situated at the left ureteral orifice. A somewhat smaller tumor was found near the right ureteral orifice and the bladder wall beneath both tumors was markedly infiltrated. Below the bifurcation of the aorta the lymph nodes were markedly invaded with tumor cells. This case was one of a small bladder tumor giving rise to extensive pelvic carcinomatosis with metastasis to the lymph nodes.

The fifth patient was a man who had been employed in the dye industry for 30 years. He was hospitalized February 15, 1952 because of painful micturition. An attempt was made to perform an exeresis but because of the extent of the tumor, only a ureterosigmoidneostomy was done. On April 19, 1952 a frontal lobotomy was done because of a severe psychiatric disorder. The patient died on May 11, 1952. At autopsy, metastases to the base of the brain and along the arteries of the corpus striatum were demonstrated.

The sixth case was that of a man 51 years of age, who, on January 25, 1953, was hospitalized because of dysuria and hematuria. On exposure of the extraperitoneal space, three large nodes, 4 cm. in length, were discovered adherent to the external iliac vein. It was impossible to do a total cystectomy because of the extent of the tumor, but as much of the tumor as possible was resected. This patient had a metastasis to the lymph nodes with a vesical tumor that could be classified as belonging to Group C of Jewett.

A woman 50 years of age sought relief from hematuria of 3 months' duration. A partial cystectomy was done for removal of a tumor 2 cm. in diameter. Several months later the patient was examined because of headaches, and it was determined that she had a cerebral tumor. No autopsy was performed on this woman, but it was assumed that she had a cerebral metastasis from a bladder tumor.

On March 20, 1953 a cystotomy was performed on a man 67 years of age. A sessile tumor was found on the anterior surface and left side of the bladder. The general health of the patient was too poor to permit a cystectomy. Death occurred on May 10, 1953. Numerous lymphogenous metastases along the lumboaortic chain were found at autopsy. The left adrenal gland was the site of a metastasis the size of a small mandarin. In this case, a bladder tumor had metastasized to the adjacent lymph nodes and to the adrenal gland without evidence of pelvic carcinomatosis. —*Conrad A. Kuehn, M.D.*

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

The Relationships Between Vascular Anomalies of the Soft Tissues and Bone Changes (Die Beziehungen zwischen Weichteilgefaessmissbildungen und Knochenveraenderungen). H. MAU. *Zschr. Orthop.*, 1953, 84: 216.

THE author presents 2 case histories evidencing a possible relationship between an angioma of the skin and bone changes.

The first patient was a 14½ year old boy who, since birth, had had a cutaneous angioma in the region of the left lower leg. This spot had continuously enlarged. At the time of examination there were present elevated cavernous hemangiomas on the lateral aspect of the left lower leg, reaching to about its midlevel, and on the posterior aspect there was a distribution in spots reaching as high as the popliteal space, where one fleck measured about 5 c.c. The outer side of the crural region, on the left, was somewhat warmer to touch than on the right side. The left leg was somewhat more heavily built than the right leg and (measured from the anterior superior spine of the ilium to the tip of the medial malleolus) the left lower extremity was 4 cm. longer than the right, 3.5 cm. of this extra length representing that of the tibia. The left foot was also 1.5 cm. longer than the right.

The second report concerned a 57 year old man who, since childhood, had exhibited over the basal phalanx of the right little toe a cutaneous angioma which had never increased in size. On the occasion of the impingement of this area on an iron obstacle the patient began to experience pain in this area, and 4 months later he exhibited, in addition to pain on pressure, and redness of the involved toe, an approximately cherry-sized, long-oval, dark brown to reddish spot (angioma simplex). The roentgenogram again disclosed the cyst in the basal phalanx of the little toe on this side, which, in contrast to previous roentgenograms, now disclosed some evidence of bone structure and was somewhat more sharply delineated. The corticalis showed some increase in swelling in comparison with the previous roentgenogram. There was an evident infraction of the bone in the area of the cyst.

The contents of the cyst were excochleated and the lesion proved to be an enchondroma. There was no evidence of vascular connection between the angiomatous lesion and the cystic bone lesion.

The author believes that in these 2 instances there might be postulated some causal connection between the hemangiomas and the concomitant bone changes. In the first instance here reported he suggests that the connection between the blood vascular lesion and the partial gigantism might have to do with the extra blood supply to the epiphyses. It is known that two-thirds of the growth in length of the tibia occurs in the proximal epiphysis, and the large simple angioma overlying this area would seem to lend support to such a viewpoint.

The connection between the enchondroma and the angioma in the second patient might be referred further back to a dystrophic involvement of this area. It is known that enchondromas are encountered not uncommonly in such conditions of the skeleton as partial gigantism; however, the eventual solution of these questions must be left to further observations of this nature, particularly in the form of histologic studies. —*John W. Brennan, M.D.*

Solitary Unicameral Bone Cyst. GEORGE J. GARCEAU and CHARLES F. GREGORY. *J. Bone Surg.*, 1954, 36A: 267.

THE authors present 27 cases of solitary bone cyst and have added 87 cases of unmistakable bone cyst from the literature. They suggest that since the basic pathologic process is one of bone resorption, it is most likely to be associated with remodeling which has got out of control. They have classified the cases as either "active" or "latent" according to the method of Jaffe and Lichtenstein. The active phase of the cyst is construed to be that state in which the cyst is actively enlarging, while in the latent phase the cyst remains quiescent and the epiphyseal plate migrates away from it. A latent cyst shows normal bone between it and the epiphyseal plate, whereas the active cyst is adjacent to the epiphyseal plate. This differentiation assumes clinical importance in this study.

The authors review the roentgen, gross, and microscopic pathology as well as the differential diagnosis. Of one-hundred and fourteen cases of bone cyst studied, 65 per cent have incurred a fracture. The authors generalize that obliteration of the cyst does not usually follow a fracture, but that in 15 per cent of the cases which fractured, obliteration of the cyst occurred after no treatment other than that applied for fractures. Of the three forms of treatment, namely, roentgen therapy, transplantations of autogenous or homogenous bone grafts, and total resection of the cyst, the authors believe that curettage with bone grafting has given the most consistently satisfactory results. In all the cases studied, the authors emphasize that cysts treated in the active stage are more likely to recur than those treated in the latent stage. They also point out that the incidence of recurrence is much greater when the cyst is treated under the age of 10 years than when it is treated in older patients.

In the authors' series, 2 patients were treated by x-rays only, with failure in both cases; 3 patients were treated by curettage only, with failure in 1 case. The remainder were treated by curettage and some method of bone grafting, and of 16 patients so treated, there were only 3 failures. In a general way, this was consistent with the results reported in 87 cases culled from the literature. The overall results, independent of the type of treatment, the state of the cyst, or the age of the patient indicate that the incidence of recurrence is somewhere between 21 per cent and 26 per cent, despite the form of treatment.

—*Norman J. Rosenberg, M.D.*

Tuberculosis of the Spine. An End Result Study of the Effects of the Spinal Fusion Operation in a Large Number of Patients. HALFORD HALLOCK and JAMES B. JONES. *J. Bone Surg.*, 1954, 36A: 219.

THE authors review the spinal fusion operations performed at the New York Orthopedic Hospital from the years 1931 to 1947 inclusive, and review the work of Hibbs and Risser and Swift, who did a similar study on patients operated upon during the period between 1911 and 1930 inclusive.

A total of 192 new patients with tuberculosis of the spine were operated upon and studied statistically regarding area of involvement, number of vertebrae involved, associated tuberculous disease, change in deformity following fusions in children, incidence of pseudarthrosis, paraplegia both early and late, and total end results. Of the 817 old cases previously reported from the New York Orthopedic Hospital, it was possible for the authors to obtain follow-up data on 116 patients. This is an excellent article with fine illustrations. —*Norman J. Rosenberg, M.D.*

Instabilities of the Knee Joint and Their Treatment (Les laxités du genou et leur traitement). M. GUILLEMINET and TRAN-NGOC-NINH. *Lyon Chir.*, 1954, 49: 35.

THIRTY-SIX cases of flail knee joint have been observed on the authors' service; however, only 32 operations were performed (22 syndesmoplasties and 10 operations on the bone). Finally, only 14 cases could be followed through to the time of the authors' study, and this number, therefore, provided the material on which the present article is based.

Of these 14 cases, 58.3 per cent were instances of primary (posttraumatic) lesions of the ligaments; the others consisted of genu valgum, genu varum, coxalgia, muscular paralyses about the knee, and 1 case of arthritis. One of these patients was operated upon by the method described by McMurray in 1916; 1 by the method of Edwards (1920); 4 by the method of G. Marchant; 1 by the method of G. Marchant, double procedure; 2 by the method of Hey Groves-Smith, and 1 by the "cadre" method of Laroyenne. There were 2 capsulorrhaphies.

In view of the small number of cases, and of the indefinite ultimate results, the authors suggest that the methods of Edwards and of Marchant be used for isolated reconstitution of a lateral ligament, and that the method of "suture en cadre" of Laroyenne is best for the complex forms of knee instability.

In trying to evaluate the terminal results, the authors have relied on a numerical evaluation of the different functional signs (pain, fatigue, stability when walking, professional activity, and activities in sports), on the evaluation of physical and roentgenologic findings (deformities, useful mobility, total relaxation, and muscular force), and finally upon the personal appreciations of the patient. The sum of these 10 elements permits a balancing of the different terminal results as against the normal subject and the previous condition of the patient himself.

On the basis of the above numerical appreciations, the authors were able to deduce the better prognosis of early treatments, the importance of rapid recuperation of the muscular force, and the doubtful prognosis of a repetition of operative therapy. On the whole, the nontraumatic instabilities offered a better prognosis than the traumatic ones.

The authors emphasize the fact that care in the details of performance of the operation frequently offers a better prognosis than the type of operation employed. —*John W. Brennan, M.D.*

Malignant Synovioma Simulating Adamantinoma of the Tibia. H. LEDERER and A. J. SINCLAIR. *J. Path. Bact.*, Lond., 1954, 67: 163.

THE authors report the case of an 11 year old girl with primary synovioma of the tibia. At the initial operation the true nature of the lesion was not determined. Following its recurrence, in 1947, the original slides were reviewed and a malignant tumor mass found. The histologic characteristics of the tumor in the surgically amputated mass were those of a malignant synovioma. The patient subsequently died and an autopsy was not permitted.

These authors review the relationships of this type of tumor to the "adamantinoma" of the tibia and conclude that the adamantinoma and synovioma are identical tumors. They recommend that the entity of the adamantinoma be discontinued and suggest that all such tumors previously reported were synoviomas. The majority of these tumors are generally regarded as benign. The authors stress the clinical attribute of recurrence after local excision, insensitivity to radiation, and (in infrequent cases) the tendency to metastasize. —*Daniel H. Levinthal, M.D.*

Report on 2 Cases of Ledderhose's Disease (Deux cas de maladie de Ledderhose). F. FRANCON and J. FRANCON. *Presse méd.*, 1954, 62: 143.

THE first case was that of a 63 year old physician who had led an extremely active life during his years of practice in a small town in the south of France. This patient had suffered a number of infirmities (chronic enteritis, traumatic hydrarthrosis of the knee joint, pleuritis, mushroom poisoning). He appeared on the authors' service at Aix-les-Bains, France, complaining of pain in the left heel. The following year, mobile, painless nodules developed on the plantar fascia of both feet along the medial border of the arch. Neither colchicine nor atophan had any effect on the nodules and the condition was diagnosed as "malady of Ledderhose." In this instance there was no evidence of Dupuytren's disease.

The second patient was a 45 year old woman with hepatic crises, who had suffered a fracture of the tibia with long immobilization and subsequent stiffness of the ankle joint. Later she developed pains in both knee and ankle joints (bilateral arthritis deformans of the knee joints). Finally a nodule developed on the flexor tendon of the medial aspect of the arch of the left foot. This condition spread anteriorly and posteriorly to a total length of approximately 2.5 cm., and it was not painful except on direct pressure and with extension of the great toe. There was no evidence of Dupuytren's contracture.

The general condition of the patient improved under the spa treatment; however, the nodules remained unaltered. Again there was no response to colchicine and a diagnosis of malady of Ledderhose was made.

In both of these cases the general condition of the patient was good, the foot affection was not especially bothersome, and aponeurectomy was not considered necessary. —*John W. Brennan, M.D.*

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

The Pathophysiology of Pseudarthrosis (Die Pathophysiologie der Pseudarthrose). M. Dubois. *Helvet. chir. acta*, 1953, 20: 334.

The author believes that since so much of the biological background with reference to the healing of fractures is unknown, the surgeon who must treat the patient with pseudarthrosis must at present divert his greatest energies to testing the various types of mechanical treatment; that is, he must study the results to be expected from immobilization procedures, from pressure treatment methods (Greifensteiner and Wustmann), and from the various procedures of interposition (cancellous bone chips of Matti) and juxtaposition (onlay grafts of Phemister).

It is probable that little more is to be learned from the histologic studies of pseudarthroses; the author has examined the histologic specimens obtained from operations on pseudarthrotic patients, and he finds such studies a matter of dreary repetition. There is always the failure of invasion of the fibrous or the cartilaginous callus by newly formed capillaries, perhaps the sole agent in supplying the necessary calcium for the formation of new bone. There is always present the pseudarthrotic cleft, perhaps evidencing osteoblastic activities and perhaps indicating only necrosis and osteoclastic processes. The entire picture is always one of inhibition of differentiation of the callus at a critical stage of its development; however, all this is well known. The capillaries end at the borders of the original break; the blood circulatory mechanism ends in the form of rudimentary bone tissue and rudimentary blood vessels at the pseudarthrotic zone, thus forming the histologic component which prevents the marrow tissues and the other elements of healing from participating in any process of consolidation of the fracture itself.

We do know that biologic processes play a dominant role in the process of healing—and its obverse manifestation, the formation of pseudarthrosis. The very fact that pseudarthrosis is so common in children —and it is in these youthful individuals that one finds the intractable form of the anomaly—excludes the possibility of the sole participation of purely mechanical factors in the formation of this lesion. The lesions in the young are just the ones that may resist all forms of retentive therapy. However, no form of hormone or of vitamin therapy has been demonstrated to be of any considerable effect in the process of ossification of the callus.

The congenital forms of pseudarthrosis have frequently been pronounced incurable, yet today they are being cured. The tissues involved in the pseudarthrosis are differentiated fully, viz., their biologic potentialities are slight; however, these potentialities are not completely exhausted, as has been demonstrated by the results obtained in pseudarthroses of the femoral neck by the direction-of-force changing osteotomy of Pauwels, the onlay graft of Phemister, and the over-bridging method of Schloessmann. Nevertheless the author does not accept unconditionally the assertion that the problem of pseudarthrosis has been solved, and he points to the great number of therapeutic measures which have been proposed, as evidence that a satisfactory solution has not yet been reached.

At present the measures promising the greatest efficiency in the treatment of pseudarthrosis seem to lie in providing the requisite mechanical adjuvants; however, this suggestion is only to be taken in the broadest sense and should never exclude the application of such biologic knowledge as we at present have at our disposal. It is only by consideration of all the factors involved that the surgeon faced with the problem of pseudarthrosis will be enabled to make a wise choice of treatment among the very great number of procedures proposed.

—*John W. Brennan, M.D.*

Arthrodesis of the Knee Joint Following Resection, Obtained by Means of an Apparatus for Immobilization, and Without the Use of a Plaster Cast (Arthrodèse du genou, après résection, obtenue au moyen d'un appareil d'immobilisation supprimant le plâtre). J. Michail and Z. Christou. *Helvet. chir. acta*, 1953, 20: 483.

The authors have been performing arthrodesis of the knee joint in instances in which infantile paralysis has resulted in paralysis of the quadriceps muscle. These children have been forced to walk hunched over, with one hand bracing the knee, or have been wearing an orthopedic appliance which tends to obstruct the circulation of the extremity and to aggravate the trophic disturbances already present.

The same objections may be adduced against the use of a cast following the operation itself. The leg starts to swell, becomes painful, and the cast has to be loosened, with danger of the apposed bone surfaces slipping out of place, and of the production of a pseudarthrosis.

In order to avoid the use of a cast following the operation of arthrodesis, the authors have had constructed, and are employing, an appliance which is illustrated in the original text. The appliance consists of 3 steel bars, 18 cm. long, 1 cm. wide, and 2 mm. thick. These bars are perforated by holes for adjustment purposes, each hole just large enough to fit snugly around the two large steel needles, or nails, which traverse the bone ends from side to side, and engage the perforations on each side of one of the bars above described. These two bars are then fastened to the third bar, which is placed behind the knee, by means of the arched bars (ailerons) which hold the appliance firmly together and maintain approximation of the two bone ends as closely as desired.

When this appliance is in place the patient is able to be up and about almost at once, and after 2.5 months consolidation is complete. In the original text photographs show the apparatus in place on one of the authors' patients and, by means of a roentgenogram, the actual skeletal conditions are clearly depicted. —*John W. Brennan, M.D.*

Pantalar Arthrodesis. A One-Stage Operation. Walter S. Hunt, Jr., and Hugh A. Thompson. *J. Bone Surg.*, 1954, 36A: 349.

The authors describe in detail an operation in which the talus is completely removed and replaced as a graft in order to achieve a pantalar arthrodesis. This procedure was used in 38 cases.

The general indications given for the operation are instability, deformity, and pain. The authors believe that all flail joints, complete drop feet, and calcaneal deformities are best treated by this method. The better the gluteal and hamstring musculature, the better the result. Quadriceps weakness requiring a brace can be overcome if the foot is placed in sufficient equinus. Severe genu recurvatum, genu varum, or genu valgum, and flexion contractures diminish the chances for a good result. The operation was performed for paralysis due to poliomyelitis, weakness due to other causes, fracture dislocation of the talus, and for post-traumatic arthritis.

Thirty-four of the 38 patients were children ranging in age from 8 to 18 years. Of the 4 adults, the youngest was 20, and the oldest was 46 years of age.

In all cases the talus was removed, denuded, and replaced. Thirty-one of the 34 children had a simple fusion of the joints articulating with the talus. Three of the children had, in addition, a calcaneocuboid fusion. Three of the adults had a sliding tibial graft in addition to the fusion.

The 4 adults required an average of 3 months longer than the children to obtain solid fusion. The average length of immobilization in the children was 4.8 months and in the adults, 7.75 months.

There were no instances of aseptic necrosis of the talus, sloughing, or infection. Four instances of pseudarthroses of the ankle were attributed to distraction caused by weight of the cast against an unopposed Achilles tendon, and the incorporation of a tibial Steinmann pin in the plaster, particularly in the treatment of calcaneal deformities, was advised as a preventive measure.

The criteria used in evaluating the end results are given. The average follow-up period for the series was 3 years and 10 months. Seventeen children and 2 adults (50%) were considered to have an excellent result, 31.6 per cent had a good result, and 18.4 per cent had a fair result. There were no failures.

—*L. E. Dickey, Jr., M.D.*

FRACTURES AND DISLOCATIONS

The Treatment of Pseudarthrosis and Its Results (Die Behandlung der Pseudarthrose und ihre Ergebnisse). A. M. Fehr. *Helvet. chir. acta*, 1953, 20: 355.

In war-spared Switzerland, the cases of pseudarthroses coming to treatment during the past 10 years have not been so numerous as to permit of the individual surgeon arriving at statistical conclusions on the basis of his own material. Therefore the author sent out questionnaires to the large surgical and orthopedic clinical centers of Switzerland. Sixteen answers were received, representing a statistical material of 531 patients.

There were 401 patients with pseudarthroses of the long tubular bones. Of this number, 302 (75%) procured bony union, 49 patients (12%) remain unhealed, and 50 (13%) could not be located. These general results do not compare too unfavorably with the results reported by individual clinics.

In 59 of the 302 patients, a combination of the Kirschner method (splitting up of the bone ends) and the method of Beck (multiple drill holes) was used, and in this group the cures amounted to 85 per cent; in 51 patients the Kuentscher nail was used, with healing in 73 per cent; 10 operations were done with use of the double-wire method of Greifensteiner and Wustmann, with healing in 80 per cent; 163 operations were performed with some form of bone graft, with healing in 79 per cent; 30 operations were done with use of the Phemister type of onlay bone graft, with healing in 60 per cent and, finally, 29 operations consisted of the Matti method of packing with cancellous bone chips, with healing in 75 per cent.

The author believes that the Kirschner method, which is still relatively new, is not yet ready for full evaluation; the same may be said for the method of Phemister; nevertheless, the author himself has been using the Phemister method and he appends some roentgenographic reproductions to show that he has actually obtained strong union with this method; in fact, one of his patients, who had obtained bony union with the Phemister method, later suffered another fall with refracture of the previously pseudarthrotic tibia; this time, however, the break did not occur in the area of the previous one, but distally from it.

Of these long tubular bones, not too much difference was noted in results, no matter which bone was involved. In the humerus, healing resulted in 65 per cent; in the forearm and lower leg, 76 per cent; and in the femur, 84 per cent.

The author emphasizes that a long period of immobilization is required and he does not think that any concern as to the ultimate mobility of the joints should influence this chief requisite: "Of what use is a mobile joint if the pseudarthrosis be not consolidated properly?" Fractures of the clavicle, of the navicular bone, and of the neck of the femur receive separate consideration; however, pseudarthroses of the long tubular bones are given first attention.

In the present report the author has concerned himself primarily with the technical problems of the treatment of pseudarthrosis, although technical considerations do not exhaust the subject; the biologic aspect of the problem must always be kept in view, although the author does not know of any enteral or parenteral, or even local medication or therapy which will affect the biologic processes of ossification in any marked degree. At most, the antibiotics have proved of value in protecting the bone operated upon from infection and in clearing up more rapidly any infection present, thus permitting earlier recourse to operative intervention.

All in all, the author considers that the successful treatment of pseudarthrosis consists in a constituted proportion of one-third manual skill, one-third good sense and intuitive insight, and one-third luck.

—*John W. Brennan, M.D.*

The Influence of Cortisone in the Healing of Experimental Fractures (Die Wirkung des Cortisons auf den Wiederherstellungsprozess bei experimentellen Bruechen). A. Picchio. *Zschr. Orthop.*, 1954, 84: 352.

The tibia of pigeons was subjected to experimental fractures and cortisone was given to these animals in various doses. On the twenty-ninth day pseudarthrosis was found to exist. In the untreated animals the callus formation was complete at the end of the eighteenth day. The author presented reproductions of the roentgenograms and histological sections. The roentgenograms definitely revealed a slowing down of the healing process.

—*George I. Reiss, M.D.*

The Role of the Cartilaginous Callus in the Repair of Fractures (Le rôle du cal cartilagineux dans la réparation des fractures). P. Lacroix. *Acta chir. belg.*, 1953, 52: 877.

Thirty-two white rabbits were used in the present study. In each animal a fracture of the last rib was produced manually. Eleven days later the rib was resected and the cartilaginous portion of the callus was excised and implanted into the space between the kidney and its capsule in the same animal; then, at various intervals following the implantation, the specimen was removed and subjected to histologic study. In 1 animal the specimen was removed after 4 days; in 3 animals, after 6 days; in 3 animals, after 9 days; in 6 animals, after 16 days; in 4 animals, after 22 days; in 1 animal, after 30 days; in 1 animal, after 42 days; in 1 animal, after 59 days; in 8 animals, after 106 days; and in 4 animals after 145 days. A series of 8 photomicrographs in the original text illustrate the course of the changes through which the transplanted cartilaginous specimen passes in its new habitat.

The cartilaginous transplant, from the fourth day on, undergoes a lively process of ossification. By the ninth day endochondral bone formation has invaded the transplanted cartilaginous specimen and permeates, in rather iregular arrangement, the entire transplant and eventually almost entirely replaces it. By the twenty-second day the specimen has become transformed into a shell of endochondral bone enclosing a medullary cavity occupied by a lax connective tissue. By the thirtieth day the shell of primary bone formation is replaced by a bony cortex of rather typical lamellar arrangement and the medullary cavity becomes transformed into a hematopoietic marrow tissue.

After the thirtieth day the evolution of the tissue changes becomes sluggish; however, up to the one-hundredth day there is still evident a hematopoietic marrow tissue and an enclosing shell of lamellated bone. In some specimens the lamellated bone predominated; usually, however, the cortical bone shell tended to become resorbed (atrophy of disuse) and the nodule of marrow tissue tended to dominate the field. There seemed to be at work an inverse relationship between the bone tissue and the marrow tissue.

At any rate the transplanted cartilage seemed capable not only of initiating and sustaining the osteogenic processes, but of actually guiding the direction and arrangement of its activities.

A study of this nature was recently published by Urist and McLean (*J. Bone Surg.*, 1952, 34-A: 443; abstract in *Surg. Gyn. Obst., Internat. Abstr. Surg.*, 1952, 95: 387), who used various constituents of the skeleton engrafted into the anterior chamber of the eye of the white rat. Despite the divergence in the type of animal used and in the site of the implantation, the results of these authors were quite similar to those reported by the author in his previous studies; however, the author's work did not deal with cartilage, and he consequently undertook the present study to fill this gap in his observations.

The author believes that the results reported by these American authors (Urist and McLean) and his own results, as here reported, tend to substantiate his view that the impetus toward these changes arises within the cartilage itself.

—*John W. Brennan, M.D.*

The Operative Treatment of Fractures of the Distal End of the Humerus in Children (Ueber die operative Behandlung der Frakturen des distalen Humerusendes in Kindesalter). R. Scharpff. *Helvet. chir. acta*, 1953, 20: 459.

Three hundred and twenty-four children were treated during the period from 1941 to 1950 in the surgical department of the Pediatric Clinic of the University of Zürich, in Switzerland, for fractures at the distal end of the humerus. Indications for operative reduction were placed in 57 (17.8 per cent) instances. Fifty-one of these patients could be found for follow-up control. The period of control ranged from 1 to 9 years (average, 4 to 5 years).

Of these 51 ultimately controlled fractures, 35 were condylar transverse fractures, 7 were fractures of the radial condyle, and 9 were fractures of the ulnar epicondyle.

In the transverse condylar fractures, operation was considered indicated when the displacement could not be corrected or the fractured fragments satisfactorily maintained in reduction, particularly in cases in which the redislocation resulted from the necessity (because of threatened ischemic contracture) of loosening the arm from its self-splinting position of extreme flexion. Where the threatened ischemia was the result of a very large hematoma, operation consisted of removal of the hematoma and fixation of the fragments.

In 8 of these children the fixation was accomplished by nailing; in the remaining cases the fixation consisted in the oblique passage of Kirschner nails through the fragment and shaft of the humerus, and use of the Sachse apparatus for their introduction. The operative treatment resulted in satisfactory function in 80 per cent of this series of condylar transverse fractures of the humerus.

Incidentally, the Kirschner wire method was also employed in those instances in which the fracture could be reduced by hand, but in which, due to the risk of ischemia, the fragments could not be adequately fixed otherwise, with the arm in the deflexed position. In every instance in which the Kirschner wire fixation was employed in this series of condylar transverse fractures of the humerus, the results were satisfactory. In fact, the wire through the skin tended to

provide outlet for any subsequent development of hematoma, and there was no instance of infection following this method of treatment.

In fractures of the radial condyle and of the ulnar epicondyle, operation was considered indicated in instances of major dislocation, and in cases in which manual reduction was not successful. Here again the fixation was made by means of the Kirschner wire and in all these cases the results were satisfactory.

With exception of the possibility of infection, which today seems to be completely controlled by the use of the antibiotics, the reservations with regard to the operation for fractures in children are still observed. In the case of fractures of the lower end of the humerus, however, there seems to be a definite place for surgery. A prerequisite for a good terminal result in these lesions consists in an exact reduction and firm fixation.

—*John W. Brennan, M.D.*

Central Dislocation of the Femoral Head Treated with Mold Arthroplasty. ANDERS WESTERBORN. *J. Bone Surg.*, 1954, 36A: 307.

IN a series of 500 cases of pelvic fractures reported by the author in 1928, the acetabular floor was fractured in 64 cases and in 21 cases the femoral head was dislocated centrally to a varying degree.

The prognosis of these acetabular fractures, especially those with central dislocation, is poor when they are treated conservatively. The range of motion of the joint gradually decreases, and increasing pain may considerably disable the patient. Symptoms for the most part are due to severe osteoarthritis which often results from such fractures.

Fifty-one of the cases of acetabular fractures included in the 1928 series were reviewed with an interval between the accident and the follow-up examination of at least 2 years. Of these, only 26 patients recovered the working capacity which they had had previous to injury. Of 30 patients with acetabular fractures without central dislocation of the femoral head, 20 recovered the working capacity they had had prior to injury; of 12 patients with slight central dislocation, 5 recovered their working capacity. However, only 1 of 9 patients in whom the dislocation had been classed as complete was symptomless.

Treatment of these fractures with marked central dislocation is quite difficult. Closed reduction and traction or manipulation alone are unsatisfactory. Open reduction is a major procedure and does not allow one to loosen impacted fragments and gain correct reposition, which is necessary if reduction is to be maintained.

Up to 1953 the author has performed Smith-Petersen cup arthroplasties in the treatment of six central dislocations of the femoral head and he describes his technique. The results in at least 5 of the 6 patients have been encouraging. In 4 patients in whom the treatment has been completed, hip movement is practically normal and painless, the joint is stable, limp is insignificant, and walking gives little trouble. Four patients have returned to their regular work. The fifth patient is still under treatment. The follow-up interval in these patients has been 3 years, 2 years, 15 months, 14 months, and 6 months respectively.

—*L. E. Dickey, Jr., M.D.*

Fracture-Dislocation of the Hip. An End Result Study. MARCUS J. STEWART and LEE W. MILFORD. *J. Bone Surg.*, 1954, 36A: 315.

THE present article deals with the treatment, complications, and end results of fracture-dislocation of the hip, based on follow-up examinations of 128 of a total of 193 patients. In assessing the results, only patients who had been followed up for 1 year or more were included. Of the 128 patients in this category, 95 had been treated by closed or manipulative reduction and 33 had been treated by surgery. Five patients died during manipulative reduction, leaving 123 for study. Seventeen of these were followed up for 1 to 2 years, 56 for 2 to 10 years, and 50 for 10 years or longer.

Seventy-two per cent of the total number of dislocations were the result of automobile accidents, 21 per cent were produced by falls or falling objects, and 7 per cent were due to other types of trauma. The patients' ages ranged from 4 to 76 years, 75 per cent being between 16 and 50 years of age.

In classifying dislocations, the authors referred to a type (indicating the position of the dislocation), and a grade (indicating the severity of the acetabular or femoral head fracture), with a separate classification for central dislocations. Clinical and roentgenographic findings were combined in classifying the results.

Of 90 patients treated by nonsurgical methods, 36 presented excellent or good results and 33 fair or poor results.

Of 33 patients treated surgically, 5 were subjected to a reconstructive procedure as the first operation. Three of these presented good results (all were arthrodesed), 1 a fair result following a Whitman reconstruction, and the fifth presented a poor result following a vitallium-cup arthroplasty. Of the remaining 28 patients, 21 presented fair or poor results, while 7 presented excellent or good results.

Both the surgical and nonsurgical groups were studied with regard to the influence of the time elapsing after injury before reduction. They concluded that hip dislocation is an emergency demanding immediate reduction and should take precedence over all other skeletal and even abdominal injuries. Open reduction of the acetabular fragments may be delayed for a week or 10 days, provided the dislocation of the femoral head has been reduced.

It was believed that the results following reduction of dislocation of the hip are not materially affected by the age of the patient. Early, active, and vigorous exercise to restore muscle function and to prevent articular cartilage degeneration is a major feature of therapy, and no evidence was seen that such exercise promoted the deposition of calcium or development of myositis ossificans.

Avascular necrosis developed in 15.5 per cent of the patients treated by closed reduction and in 40 per cent of those treated surgically. However, it was pointed out that the time between injury and reduction averaged 3 days in the first group and 21 days in the second. The average interval before its appearance in both groups was 17 months.

It is thought that postoperative immobilization is necessary only to maintain stability, and there is no indication for prolonged nonweight-bearing in stable

fractures. Nor was there any evidence that early weight-bearing affected the end results in stable fractures.

Arthritic changes developed in only 48.8 per cent of the patients treated by nonsurgical methods compared to 71.4 per cent of those in whom surgical reduction was done. Arthritis develops in direct proportion to the severity of the fracture and the extent of vascular damage.

Of the 128 patients in the series, 13.3 per cent sustained a sciatic nerve injury. No relationship was seen between nerve injury and recovery of the hip. Such nerve injuries warrant exploration if their effects persist for 2 weeks without improvement.

Myositis ossificans developed in only 2 of 90 patients treated by manipulation but was seen in the majority of those treated surgically, particularly when a posterior incision was used.

No deaths occurred in the surgical group, but 5 deaths took place among the patients treated by nonsurgical methods. Four of these occurred prior to 1936, and the mortality decline is attributed to modern antibiotic therapy associated with advances in the treatment of shock and visceral trauma.

—L. E. Dickey, Jr., M.D.

Contribution to the Subject of the Hahn-Brandes Plastic Operation (Beitrag zur Hahn-Brandesschen Plastik). JUERGEN FISCHER-WASELS and RUDOLF WILDE *Zschr. Orthop.*, 1954, 84: 393.

THE authors present case reports of 5 patients on whom the Hahn-Brandes operation was performed. The purpose of the article was not to add something new to the subject, but merely to bring to the attention of the profession a method for the treatment of pseudarthrosis, particularly treatment of the congenital type of pseudarthrosis, which has been given all too little consideration by the surgeon.

A series of sketches and roentgenographic reproductions in the original text render the modus faciendi and the results obtained obvious. All of the patients were young and the substituted fibula tended to assume its new task in a compensatory manner; thus, Fig. 9 shows that the fibula, 4 years later, has assumed almost the dimensions of the tibia for which it is substituting.

The operation itself is long and difficult. The exact cabinet-maker-like mortising of the upper end of the fibula into the upper tibial fragment is essential to success. The great advantage of the method lies in the repair of the defect with the use of a fully functionable, living shaft of bone, while the autogenous or heterogenous transplanted bone graft must be transformed into a new bony shaft before it is capable of assuming an active weight-bearing function. Such a transformation in the presence of a large defect is problematical.

A second advantage of the Hahn operation is that of the possibility of correction of the varus deformity at the same time. This correction was attained in 3 of the authors' 5 patients.

A third advantage of the operation is the possibility that it may be performed in a not completely aseptic field. The procedure can be undertaken even in the presence of a fistula. With this method, the usual prohibition ("do not operate until 2 years after closure of the last fistula") pertaining to the other plastic repairs of this condition does not apply. The living bone and the simple protection of the antibiotics offer sufficient resistance to an infective process, without sequestration. Of course, the treatment cannot be considered as completed when the fibula has become consolidated by bony union with the upper fragment of the tibia (after 4 to 6 months' time); however, the necessity of continuing to wear an orthopedic appliance for 1 or 2 years after the operation is of small moment compared to the need to wear such an appliance for an entire lifetime, and in those instances in which the varus position is not corrected, the appliance is not only a source of discomfort and expense, but it is actually difficult to construct an appliance with sufficient sturdiness to endure for any considerable length of time. *—John W. Brennan, M.D.*

FIG. 1. (Fischer-Wasels and Wilde). Four years after operation.

Obstacles to Reduction in Subtalar Dislocations. BALDO LEITNER. *J. Bone Surg.*, 1954, 36A: 299.

DURING a 25 year period 4,125 traumatic dislocations were seen, of which 42 were recent subtalar dislocations. Thirty-six of these subtalar dislocations were medial, 5 were lateral, and 1 was posterior.

Four patients presented obstacles which hindered or prevented normal closed reduction. In 3 of the 4 cases, open reduction was necessary because of the nature of the dislocation—2 of the 3 having an impacted navicular in the fractured talar head and 1 having an impaction of the ligamentum cruciatum cruris. In the fourth case surgery was necessary because of an accompanying subluxation of the talus, around which the peroneal tendons had become twisted.

The cases are reported in detail.

—L. E. Dickey, Jr., M.D.

ORTHOPEDICS IN GENERAL

An Experimental Study of the Effect of Cortisone on the Healing Process and Tensile Strength of Tendons. RICHARD N. WRENN, J. LEONARD GOLDNER, and JOSEPH L. MARKEE. *J. Bone Surg.*, 1954, 36-A: 588.

PERITENDINOUS adhesions have always been the stumbling block of tendon repair and restoration of function. Many materials have been used to prevent peritendinous adhesions after tendon repair. Some of these are: fat, muscle, polyethelene tubes, cellophane, and catgut; none, however, has proved entirely satisfactory. Carstam described and employed cortisone to enhance the gliding effect of a repaired tendon with minimal postoperative adhesions about the tendon. This adjunctive therapy has distinct advantages in suppressing fibroblastic reaction about the site of the tendon anastomosis in the experimental animal.

Twenty-one healthy dogs were given 10 mgm. of cortisone per kilogram of weight twice daily. Medium braided stainless steel sutures were used. After from 1 week to 6 weeks the dogs were sacrificed and the relative tensile strength of the tendons was assessed. In another series, 69 tendon sutures were done on 23 dogs. The animals were divided into 3 groups.

Group I consisted of 22 dogs receiving no cortisone. At autopsy the site of tendon repair disclosed a dense, firm, adherent mass of fibrous tissue. In these animals a paucity of delineation was observed between the tendon and peritendinous structures, comparable to a Pannus formation.

Group II consisted of 47 tendon sutures in dogs receiving cortisone. The time of examination varied from 7 to 42 days. In these animals a minimal fibrous reaction was observed, the tendon ends were sharply defined, and smooth, with little edema. Hence, peritendinous adhesions were at a minimum.

Group III comprised 20 tendons chosen from groups I and II—10 tendons treated with, and 10 without cortisone. Invariably this group showed the same essential clinical results as those obtained in Groups I and II, respectively.

In conclusion, while all the tendons, with and without treatment with cortisone, healed sooner or later, one fact is pointed out by these investigators, i.e., cortisone-treated dogs had minimal adverse intercellular reaction in situ, which eventually healed, and when cortisone was given 7 days preoperatively the peritendinous fibrosis was even less. However, the tensile strength of the cortisone-treated tendons was 40 per cent less than that of the control group at 21 days after operation. The average breaking point of the control tendons was at 3.950 gm., in contrast with 2.400 gm. when cortisone was used. The intravenous administration of gelfilm, gelfoam, and pyromen reduced the degree of fibrous tissue proliferation at the site of tendon repair. —*Samuel L. Governale, M.D.*

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Major Diseases of the Abdominal Aorta. WILLIAM S. DYE and ORMAND C. JULIAN. *J. Am. Geriat. Soc.*, 1954, 2: 179.

THE authors discuss the diseases of the abdominal aorta with particular attention to progressive obstruction by arteriosclerosis and aneurysmal formation. In their experience, arteriosclerosis was the cause of all the aneurysms. They found that diagnosis was aided by aortography, and it provided information pertaining to the extent of collateral circulation and the size and state of vessels distal to the lesion.

Treatment of chronic progressive obstruction with vasodilators and lumbar sympathectomy has given disappointing results. Recently, surgical procedures including thromboendarterectomy and segmental resection with homologous arterial grafting have been carried out. The end results of these procedures will have to wait for follow-up studies. The importance of aneurysms of the abdominal aorta lies in the fact that almost all are eventually fatal. In Estes series, 63 per cent died as a result of rupture. Symptoms may include vague pain in the back or legs, unless erosion occurs, when the backache may become severe. The symptomatology changes abruptly when a complication such as massive thrombosis, rupture, or dissection occurs. The latter produces acute, severe symptoms with a shocklike picture, and if it progresses upward may cause pain in the chest.

Aortography is of value in the diagnosis of aneurysms and in outlining operative procedure. The most satisfactory methods of treatment are those which restore continuity of the aorta after resecting the aneurysmal mass. In saccular aneurysms this can be accomplished without grafting by removing the sac and restoring continuity by arteriorrhaphy. Actual resection of the aneurysmal sac with the use of homologous arterial grafts has been accomplished and promises to be the definitive treatment for this disease. Graft replacement of the terminal aorta and bifurcation requires an arterial graft, because vein grafts may dilate unless supported.

Acute occlusion of the abdominal aorta is most frequently due to emboli originating in intracardiac mural thromboses, or from atheromatous plaques of the aorta. In patients with previous partial occlusion, the symptoms depend on the collateral circulation. In a patient with aortic bifurcation embolism, and completely nonviable extremities, the only life-saving procedure is embolectomy. The reason for the limited number of successful embolectomies is that many of these patients are in very poor condition and tolerate anesthetics poorly. In classic aortic bifurcation embolism, the procedure is a direct approach to the bifurcation through a laparotomy incision under spinal anesthesia. In cases in which there is doubt as to whether the obstruction is due to thrombosis superimposed on a previously arteriosclerotic bifurcation, or whether it is due to fresh embolism, the femoral arteries should be explored first under local anesthesia, in order to determine the state of the arteries in this region. If diseased and pipestem arteries are found, this procedure precludes the necessity of giving a spinal or general anesthesia and of exploring the abdominal aorta. —*Albert M. Schwartz, M.D.*

Treatment of Abdominal Aortic Aneurysm by Excision and Replacement with a Homograft. HENRY T. BAHNSON. *Circulation*, 1954, 9: 494.

FOURTEEN cases of aortic homografting are presented. The majority of cases involved the distal aorta and were arteriosclerotic in origin. The majority of fusiform arteriosclerotic aneurysms occur below the renal vessels. The average age of the patients is 65 years. Erosion of vertebrae is quite an uncommon finding. The most usual symptoms were abdominal throbbing and mass. In some instances pain was the outstanding symptom, necessitating the use of narcotics. In all of the patients the pain was relieved by excision of the aneurysm. One patient had a definite history of abdominal trauma preceding the development of abdominal pain.

The diagnosis of abdominal aneurysm is not particularly difficult. Physical examination is usually conclusive. The use of aortograms is not usually believed to be necessary to establish diagnosis. Aortograms may be useful in determining the relationship of the aorta to the renal arteries. A roentgenogram of the abdomen will frequently reveal a rim of calcium in the wall of the aneurysm.

The prognosis in aortic aneurysm is not good. A series of patients reported on by Estes revealed that 2 of 10 with abdominal aneurysm will die from rupture of the aneurysm within a year, and that 5 of the 10 will die in 8 years. No single symptom is of value in estimating the prognosis.

The authors briefly recount the various operative procedures that have been used. Among these is the use of fibrogenic and reinforcing materials. The prognosis following this treatment was not found to be much better than that of the natural history group. The introduction of wire and use of the coagulating current are mentioned. Ligation has been attempted many times. The combination of elastic ligation with fibrogenic material and wiring seems to give fair results. Endoaneurysmorrhaphy combined with endarteriectomy has been utilized by some authors.

The technique of homografting is described. A midline incision is used. The aorta is exposed retroperitoneally from the left. Care should be exercised around the renal vessels and in freeing the aneurysm from the inferior vena cava. Most of the grafts used were freeze-dried-preserved. The aneurysm is occluded proximally with a curved Potts coarctation clamp and the iliac-arteries are occluded with Potts ductus clamps. Heparin is injected into the iliac arteries distal to the occluding clamps. This is a vital step to prevent clotting while the anastomoses

are being performed. The proximal anastomosis is accomplished with a posterior continuous-everting suture of No. 0000 silk, and an anterior over-and-over suture. The iliac anastomoses are done with an over-and-over stitch of No. 00000 silk. The proximal aorta is invariably arteriosclerotic, and intimal plaques may have to be removed before suturing begins.

Three deaths have been noted in this group. One patient died on the fourth day. He was known to have a ruptured aneurysm, and was in shock when seen. Postmortem examination showed nephrosclerosis. This aneurysm extended above the renal arteries and the renal blood flow was compromised during the operative procedure. A second death occurred 4 months after operation from coronary artery disease. The third patient died at 6 months as a result of myocardial infarction. Compromise of the circulation to the lower extremities has been a frequent complication, necessitating amputation in several cases.

There are no rigid criteria for selecting patients. Those over 70 years of age without symptoms need not be urged to undergo operation. Pain and abdominal distress are clear indications for operation. Rupture or impending disruption of the aneurysm demands immediate surgery. The contraindications to operation are few. —*Richard L. Lawton, M.D.*

Shunt Grafts. A Method of Replacing Segments of the Aorta and Large Vessels Without Interrupting the Circulation. HOWARD MAHORNER and ROWENA SPENCER. *Ann. Surg.*, 1954, 139: 439.

A METHOD is described for replacing segments of large arteries by shunt grafts while the circulation is partially maintained through the main vessel. The aorta is partially occluded with Potts or Beck clamps while the two anastomoses are being made, each end of the graft being sutured to the side of the aorta just above and below the involved vessel segment. The blood continues to flow through part of the aorta during the anastomoses. As soon as the anastomoses are completed the clamps are removed. After the integrity of the suture lines has been established, the involved segment of aorta is excised. The graft then permanently carries the circulation.

This type of procedure was carried out experimentally in dogs and the same principle was then employed in 1 human being. A 4 day old quick-frozen arterial graft was sutured to the base of the innominate artery and to the common carotid artery in order to by-pass a large aneurysm involving the innominate artery and its bifurcation. The second stage of the operation consisted of excision of the aneurysm.

The method will probably have its greatest field of usefulness in replacing segments of the upper thoracic aorta and the aortic arch.

—*Robert A. Nabatoff, M.D.*

Vascularization of 1 Year Old Homologous Aortic Grafts. SVEN BELLMAN and BENGT GOTHMAN. *Ann. Surg.*, 1954, 139: 447.

SUCCESSFUL blood vessel grafts can now regularly be made both in animal experiments and in clinical work. However, it has not been clear whether cells of the graft survive or whether the material used merely acts as a framework for the laying down of cells by the host.

In the present study an investigation was made of aortic and femoral grafts in dogs about 1 year after transplantation. The functional result was good in all of the grafts, except 1 aortic graft which was occluded by a thrombus. It was shown, by means of angiomicrography that there was a rich blood supply both in the tissue surrounding the graft and in the adventitia laid down by the host. Blood vessel penetration from the adventitia into the media was demonstrated, and also penetration into the ends of the graft from the scars which surrounded the suture lines.

It is not clear whether this vascularization should be considered as a blood vessel supply to a living tissue or as a penetration of blood vessels into a framework of dead cells. The mobilization of parts of the aorta at the time of grafting did not seem to have decreased the blood supply to these parts of the vessel. However, the fact that the type of blood vessel net differed from the normal vasa vasorum indicates that these portions of the aorta have been secondarily vascularized. —*Robert A. Nabatoff, M.D.*

The Restoration of Main Vessel Patency in Arteriosclerosis Obliterans. JOSEPH C. LUKE. *Canad. M. Ass. J.*, 1954, 70: 391.

THE author presents a description and discussion of the relatively new procedures of thromboendarterectomy, autogenous vein graft, and homologous arterial graft bridging of segmental arterial occlusion due to arteriosclerosis obliterans.

The symptomatology in these cases is almost entirely that of intermittent claudication, the level and severity of the claudication depending on the level and extent of the occlusion.

The selection of cases for these operations should be most carefully done, and femoral arteriography or aortography is essential to this selection. Patients below 55 years of age obtain better results because the disease process tends to be major in only one area of the arterial tree. A diffuse arterial involvement contraindicates this type of surgery.

Nine cases are discussed, in which vein grafting of a segmental occlusion was carried out in the superficial femoral artery or in which thromboendarterectomy was performed on the lower aorta and/or the common iliac arteries. —*Ely Elliott Lazarus, M.D.*

Arterial Occlusions Simulating Neurological Disorders of the Lower Limbs. R. S. GILFILLAN, O. W. JONES, JR., S. I. ROLAND, and E. J. WYLIE. *J. Am. M. Ass.*, 1954, 154: 1149.

PAIN in the lower extremities produced by arterial occlusion is sometimes mistakenly attributed to neurologic or musculoskeletal disorders. A distinctive feature of the pain produced by arterial occlusive disease is that it develops in proportion to exercise of the muscles of the affected area and subsides quickly when exercise is discontinued. In contradistinction to this, the pain produced by pressure on nerves is aggravated by exercise, and regresses only very slowly when that exercise is stopped.

The distribution of the pain in arterial occlusions follows a sclerotomal pattern whereas the pain of

pressure on nerve trunks or nerve roots is felt in dermatomal distribution. Reflex changes, lumbar muscle spasm, intensification of the pain by the Valsalva maneuver, and abnormal myelograms are confirmatory evidence that the disorder has a neurologic basis. Confirming the diagnosis of arterial occlusive disease are characteristic physical findings produced by the occlusion—absence or marked diminution of peripheral pulses, dependent rubor, markedly decreased oscillometric readings, and typical aortograms.

The authors present illustrative cases of arterial occlusions at various levels, with a helpful table which shows the main diagnostic differences among vascular, neurologic, and musculoskeletal lesions.

—Benjamin F. Lounsbury, M.D.

The Rationale of Arterial Repair on the Battlefield. EDWARD J. JAHNKE, JR., CARL W. HUGHES, and JOHN M. HOWARD. *Am. J. Surg.*, 1954, 87: 396.

THE authors' material is based on casualties treated at forward surgical hospitals in Korea. World War II statistics showed an amputation rate in arterial lesions of 40 per cent. With the general application of reparative vascular surgery during the Korean conflict, the over-all amputation rate was reduced to about 10 per cent. Popliteal artery ligation was followed by amputation in 75 to 100 per cent of cases in World War II; in the Korean conflict to 18 to 20 per cent.

Vital collateral circulation is destroyed by severe wounds, extensive débridement, and associated fractures. Ligation in these cases may be followed by an ever-increasing incidence of amputation. Primary arterial repair is advocated for this reason, plus its value in the general healing process of associated muscle, nerve, and bone injury and in the ultimate functional restoration of the extremity.

Following major arterial disruption, definitive vascular repair must be done within a few hours, in the most forward hospital equipped to perform such procedures. In Korea, this represented the Mobile Army Surgical Hospital. In previous wars, patients who had a major artery ligated within 10 hours of injury required amputation of the involved limb in 36 per cent of cases. If the time lag extended to 20 hours or more, this rate rose rapidly to over 60 per cent. In the Korean cases, if arterial repair was performed within 10 hours, none of the patients required amputation; and amputation was necessary in less than 25 per cent of the patients treated beyond that time.

Major arterial injury was often only recognized at the time of débridement. Prolonged application of a tourniquet produced deleterious results. The technique of repair of an artery included the use of clamps and end-to-end coaptation with a continuous everting mattress suture of No. 000000 braided arterial silk. Classical incisions were used to expose the injured vessel and extensive arterial débridement was carried out. In 75 per cent of all cases direct end-to-end suture anastomosis was employed; the remaining 25 per cent of cases had arterial continuity restored by autogenous vein grafts (saphenous or cephalic). Tension at the arterial suture line was avoided and the soft tissue wound was not closed primarily.

—S. Lloyd Teitelman, M.D.

Clinical Trial of Alpha-Tocopherol in the Prophylaxis of Thromboembolism. M. G. WILSON and E. W. PERRY. *Lancet*, Lond., 1954, 1: 486.

IN 1950 the incidence of pulmonary embolism (found at autopsy) at the Bristol Royal Infirmary was the highest it had been for 10 years. In 1951 there was a slight fall in its incidence, and in 1952 a return to a level comparable to previous years. This experience led the authors to seek some prophylactic agent against thromboembolism.

Based on the work of Ochsner *et al.* and Zierler *et al*, they began the use of alpha-tocopherol as such a prophylactic agent. Two hundred surgical cases were divided into groups of 100—one group to be treated with the drug, the other to be used as a control. All patients were more than 40 years of age, and both groups were similar in all ways. The treated group was given 200 mgm. of alpha-tocopherol by mouth, daily, and 10 ml. of calcium gluconate in 10 per cent solution intravenously. Daily observations were made on all patients. Calf tenderness was considered as an indication of mild venous thrombosis, and similar tenderness associated with edema as severe venous thrombosis.

In the two groups, there was little difference in the number of patients in whom thromboses developed—10 among the treated patients and 13 among the controls. The severity of the thromboses, however, was much less in the treated patients. In most of the latter the condition would have escaped notice because of its mildness.

The authors believe that these results support the opinion that the use of alpha-tocopherol and calcium gluconate have some effect on the degree, if not on the incidence, of venous thrombosis.

—Donald C. Geist, M.D.

Ambulatory Phlebitis of the Deep Veins of the Lower Extremity (Les phlebites ambulatoires Des veines profondes au membre inférieur). CL. OLIVIER and G. LORD. *Presse méd.*, 1954, 62: 457.

THE authors report 46 cases of ambulatory phlebitis of the lower extremities among 400 patients with thrombosis of the deep veins of the leg and thigh. These patients were so classified since they were able to be up and about during the first weeks of their illness. In each instance, the etiology was obscure. Delay of diagnosis, or failure to make the diagnosis resulted in pulmonary emboli in 5 cases, relapsing phlebitis in 4 cases, and extension of the phlebitis to both legs and the iliocaval junction in 4 cases. Edema, pain, and varices were present. In 26 cases, phlebography was used to determine the presence, location, and extent of the thrombosis.

The technique consisted of the administration of 100 mgm. of heparin, after which dye was injected into one of the dorsal veins of the foot. There were no complications. The thrombosis was usually localized in the calf, sometimes in the popliteal area and occasionally in the superficial femoral vein. In addition, it was noted that as long as the patient remained ambulatory, the lesion remained segmental in character. Collateral venous circulation was usually well developed.

In the therapy of this lesion, bed rest is contraindicated; the patient is advised to be up and about with an elastic bandage support. Anticoagulant therapy with tromexan under bi-weekly prothrombin-time control is started and maintained on an out-patient basis. Anticoagulant treatment is continued for 2 months, and support of the leg for a period of 3 to 6 months. Patients whose condition is diagnosed early and treated within 2 months of onset have an excellent prognosis. Although some may heal spontaneously, failure of early treatment may lead to bilateral involvement, ulcers, varices, and scar contractures.

—*Victor M. Bernhard, M.D.*

Roentgen Aspects of Isolated-Valvular Pulmonic Stenosis. S. Gilbert Blount, Jr., Malcolm C. McCord, Seiichi Komesu, and Raymond R. Lanier. *Radiology*, 1954, 62: 337.

Isolated pulmonic valvular stenosis is a relatively common congenital anomaly and is amenable to surgery. At Colorado Medical Center 30 cases, 23 of which were confirmed by catheterization, were seen in a 2 year period. This was 12 per cent of all the cases of congenital heart disease seen in that period.

This condition can usually be recognized by the roentgenologist without the use of complicated diagnostic procedures (cardiac catheterization and angiocardiography). The picture, however, is a variable one both clinically and roentgenographically.

Clinically, the picture varies from the absence of any signs or symptoms to marked cyanosis. Roentgenographically the picture varies from a normal-sized heart with only a dilated main pulmonary artery shadow, which shows exaggerated pulsations, to a markedly enlarged heart and relatively avascular lung fields.

Dilatation of the main pulmonary artery, and exaggerated pulsations of it were present in all cases. Decrease in the amplitude of pulsations in the right and left pulmonary artery shadows was present in all cases. Decrease in the vascularity of lung fields was present in a little more than half of the patients, and about half showed cardiac enlargement. Right ventricular enlargement could be recognized in the smaller hearts, but when dilatation occurred in addition to hypertrophy, the configuration was less distinctive. The right atrial shadow was prominent in about half the cases.

In the differential diagnosis, patent ductus and atrial and ventricular septal defects may be differentiated by the fact that pulsations of the right and left pulmonary artery are equivalent to those of the main pulmonary artery. Eisenmenger's complex may simulate it to a considerable degree, but is differentiated in the same way. Tetralogy of Fallot with pulmonic stenosis at the valvular level may require more complex procedures for differential diagnosis.

—*Lois Cowan Collins, M.D.*

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Results of Experimental Studies and Clinical Observations on Fat Embolism (Ergebnisse experimenteller Untersuchungen und klinischer Beobachtungen bei Fettembolie). HANS MOSER and PETER WURNIG. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1954, 278: 72.

INTRAVENOUS or intra-arterial injections of fat obtained from the cat's mesentery were given cats by the authors in an attempt to find an answer to the following questions: (1) Can reflex processes provoked by fat embolism and responsible for the fatal outcome be demonstrated? (2) Are there marked differences in fat tolerance between animals with a normal, and those with an impaired, circulation? and (3) Can fat pass the capillaries, how fast and under what circumstances?

Reflex action was studied by cooling and heating an exposed segment of the vagus nerve. Impairment of the circulation was provoked either by bleeding or by application of a tourniquet to both upper extremities for a period of 4 hours.

The experiments demonstrated the fact that in fat embolism droplets of fat are passing the capillaries and are retained by the latter only in the presence of hypotension. It follows that fat tolerance depends on the blood pressure and that in the treatment of fat embolism the attention of the physician should be focused mainly on the therapy of the concomitant circulatory damage, namely, shock or loss of blood. A marked effect of reflex phenomena on the circulatory system, or more specifically on the blood pressure, caused by fat embolism could not be demonstrated. On the other hand, fat injections were causing a short respiratory standstill, followed by gasping respirations. Apparently fat was producing a reflex effect on the regulatory apparatus of the respiration.

The treatment of choice consists of immobilization of the patient, the application of heat, and the administration of blood, plasma, or plasma volume replenishers supplemented by noradrenalin.

—*Joseph K. Narat, M.D.*

Comparative Experimental Studies on the Effect of Different Blood Substitutes on the Restoration of the Circulation (Vergleichende experimentelle Untersuchungen ueber die kreislauffuellende Wirkung verschiedener Blutersatzmittel). J. KORTH and H. HEINLEIN. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1954, 278: 36.

IN SEVERE acute hemorrhage with collapse the volume of the circulating blood is the most decisive factor for the fate of the patient. Therefore, rapid intravenous replacement of the circulating blood volume is of vital importance. The effectiveness of blood substitutes must be determined by measuring this volume at different times after the infusion.

The writers of this article criticize the usual methods of blood volume determination. These methods consist in the injection of a test substance and determination of its dilution effect on the blood stream. However, no substance is distributed quite homogeneously in the entire blood. Furthermore, it has been proved that the proportion of cell and plasma volume is different in different portions of the circulatory system. It is, therefore, wrong to draw conclusions from the hematocrit count of the total blood volume or of the volume of plasma and cells, respectively. Both elements have to be determined separately and simultaneously to arrive at a reliable result.

In this article, a method of measuring the volume of erythrocytes and plasma separately in the dog is described. The erythrocytes were labeled with P^{32}, and the plasma with Evans blue (T 1824). Six cubic centimeters of blood were withdrawn and incubated with 0.1 mc. of P^{32} for 3 hours. Then the erythrocytes were washed four times and the suspension was reinjected into the femoral vein together with a 0.5 per cent solution of Evans blue. Five to 10 minutes later 7 c.c. of blood were withdrawn from the femoral artery of the dog. The volume of the circulating erythrocytes was computed from the activity of the withdrawn blood specimen and the determination of the hematocrit value. The plasma volume equaled the quotient of the injected stain solution and the concentration in the withdrawn blood. The total circulating blood volume was the sum of the plasma and erythrocyte volumes.

Experimental studies by one of the authors have shown that after acute severe blood loss of 2 to 3 per cent of the body weight, the lost blood is restored in a surprisingly short time by compensatory processes of the organism. In dogs, 56 per cent of the lost blood was restored after 30 minutes and 92 per cent after 15 hours.

Therefore, in their experiments on dogs with blood substitutes, the writers infused the compounds only 15 hours after the venesection. Thus they avoided drawing wrong conclusions which otherwise could have been caused by the compensatory processes of the organism. Twelve different substances were tested, including whole blood, citrated blood, saline solution, and nine commercial products. The blood volume was measured 30 minutes and 24 hours after the infusion to determine how long the substances remained in the circulation. A product by the name of oncotine gave the best results in a large number of experiments.

—*Werner M. Solmitz, M.D.*

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Management of Acute Crushing Injuries of the Hand and Forearm over a Five-Year Period (1948–1952). JOHN L. BELL, MICHAEL L. MASON, and HARVEY S. ALLEN. *Am. J. Surg.*, 1954, 87: 370.

THE authors present 112 cases of accidental crushing injuries of the hand or forearm requiring hospital-

ization. These patients were seen during the years 1948–1952. Punch press accidents were the principal cause of the industrial injuries. The majority of injuries sustained in civil life resulted from crushing a digit in a door.

Rapid assessment of the degree of injury was done in the hospital emergency room and a compression dressing was applied, with splinting of the injured extremity, thus allowing time for history, physical examination, laboratory, and x-ray studies before transport of the patient to the operating room.

Antibiotics (usually penicillin) were given on the basis of specific indications to 106 of the 112 patients studied. All patients received either tetanus antitoxin or a tetanus toxoid booster. Eleven patients in traumatic shock were admitted, and were given blood transfusions. Eighty-two per cent of the patients were operated upon within 4 hours after the injury.

General anesthesia was employed in 108 patients. Wounds were treated by gentle soap and water cleansing, followed by careful excision of devitalized tissue. After debridement, the wounds were closed without tension by various methods: primary closure was done in 27 cases and partial split thickness skin grafts were used in 38 cases. In 6 patients, local pedicled flaps were shifted over exposed bone, tendon, nerve, or joint, and in 6 other patients primary abdominal pedicled flaps were used. There were 36 traumatic amputations, 16 of which were closed by local flaps, and 20 of which required additional split thickness skin grafts.

Forty-one patients sustained crushing wounds, complicated by open fractures, and characterized by marked comminution. Reduction was accomplished by manipulation and molding over a sterile padded splint with the hand in position of function, and the position maintained by a compression dressing. Internal fixation was not employed. Primary repair of divided digital nerves was achieved in 11 of 14 patients, and primary repair of divided extensor tendons in 19 of 20 patients. Primary flexor tendon repair was done in only 2 of 9 patients; this is generally inadvisable because of the complexity of the crushed hand or forearm. Operations were completed by the application of a resilient compression dressing and immobilization on a Universal splint.

In all but 12 patients, healing occurred by primary intention. There were few complications. Eighty-two per cent of the patients were discharged from the hospital within 14 days following injury. Twenty-nine delayed operations were required.

—*S. Lloyd Teitelman, M.D.*

A Statistical Study of Tetanus (Statistik ueber Tetanuserkrankungen). A. Huebner and K. Freudenberg. *Chirurg*, 1954, 25: 145.

This study of tetanus is based on 1,894 cases collected from 94 surgical, gynecological, and pediatric clinics in postwar Germany. In addition, the mortality statistics for tetanus in the West German Republic for the years 1949 to 1951 were evaluated. An attempt is made to assess the value and the need of a program of active immunization among the civilian population in view of the often advanced argument that the over-all incidence, morbidity, and mortality of tetanus is so small that a general program of immunization is not worth the effort involved.

The mortality rate for the 1,894 collected cases was 49 per cent. There was no difference between the sexes with respect to the lethality of tetanus. All ages from the first day of life to 80 years were represented. There was a high incidence for the newborn, a decline for the ages of infants of 1 and 2 years, and an increase for children between 3 and 14 years, while the highest incidence occurred among individuals from 15 to 50 years of age. A preponderance of cases resulted from common minor injuries which the victims considered too trivial for medical attention. Among 265 cases for which the cause was given there were 60 resulting from wood slivers, 39 following abortion, 34 from umbilical infection, 30 following surgical operations, and 26 from rusty nail injuries. Among the remaining causes, burns, leg ulcers, and unknown portals of entry ranked high.

Among the 30 cases which occurred following surgical operations, 9 followed gynecologic procedures. A variety of surgical procedures had been carried out in the remaining patients in this group. Catgut infection was suspected in a few cases but could not be proved.

The exact time of incubation could not be determined in terms of days. There was a high incidence of incubation in 5 to 14 days and another in 21 and 28 days, which indicated that the victim would date his injury approximately in terms of weeks.

A much higher incidence was reported from agricultural communities than from industrial centers, which is in accord with other statistics on tetanus.

The author concludes that a program of prophylactic immunization would be of definite benefit.

—*John L. Lindquist, M.D.*

The Treatment of Manifest Tetanus in Artificial Hibernation (Die Behandlung des manifesten Tetanus im kuenstlichen Winterschlaf). Heinz Contzen. *Langenbecks Arch. u. Deut. Zschr. Chir.*, 1954, 278: 27.

The author discusses the advantages of using artificial hibernation in tetanus and reports a severe case in a 12 year old girl who was successfully treated by this method.

In severe cases the customary management consisting of wide excision of the wound, serum therapy, and narcotics (magnesium sulfate and avertin) is not always satisfactory.

In addition to the causal treatment, prevention of repeated convulsions is the most important objective of therapy. Each attack causes an accumulation of lactic acid in the muscle cells and acidosis of the tissues. The acidosis again increases the danger of more violent convulsions, hyperthermia, and dehydration by excessive sweating. A vicious circle is established and the patient succumbs from circulatory failure.

Maintaining permanent deep sleep with hypnotic drugs involves considerable difficulties in nursing care, especially adequate nutrition, defecation, and micturition. Curarization is dangerous because of the risk of respiratory paralysis which may require intubation and artificial respiration at any time.

Artificial hibernation with a combination of sympatholytic, parasympathicolytic, and antihistaminic

drugs gives more satisfactory results. The "lytic cocktail" can be so modified that it is easily possible to arouse the patient for meals, micturition, and defecation, and at the same time to maintain complete homeostasis.

In the reported case hibernation was maintained for 6 days. Demerol and magnesium were added to the usual mixture, and the dosage was such that the patient was asleep most of the time but could be easily wakened. From the first day of hibernation the convulsions ceased completely, and the patient recovered.

—Werner M. Solmitz, M.D.

ANESTHESIA

Artificial Hibernation in War Surgery—Following Its Use in Indochina (L'hibernation artificielle en chirurgie de guerre—d'apres son emploi actuel en Indochine). C. CHIPPAUX, A. CARAYON, F. ROUFFILANGE, A. FABRE, and Others. *Presse méd.*, 1954, 62: 504.

THE present report is based on the authors' experience with 250 cases of military wounds in which treatment (in part) with hibernation was carried out. The drug used in these studies was that designated as 4560RP which, theoretically, acts upon the metarteriole and causes a vasoplegia; there is also a hypothermic effect. The pharmacologic study of this drug has not been completed, but the action of the drug appears slightly different from that of the pure ganglioplegics. It does not give the same degree of control over hypotension, and there is little effect on the cerebral blood flow, but a better distribution of the mass of blood is assured. It is necessary to restore the circulatory fluid volume adequately with blood at the time hibernation therapy is carried out. The advantage of 4560RP over other drugs, especially 9295C, in this instance is the prevention of splanchnic pooling of blood when the former is used, so that blood replacement is more effective.

Traumatic shock with peripheral circulatory depression and splanchnic engorgement is differentiated from neurovegetative derangements due to direct irritation of the brain. These can occur together in patients with blast injury, in which case traumatic shock is manifested first and the neurovegetative disturbances develop after a latent period. In isolated neurovegetative derangements, a longer duration of hibernation is necessary to prevent recurrence of symptoms. The drug, 4560RP, acts as a symptomatic agent in this instance and has little effect on the cerebral edema. In some cases, hibernation maintains the patient until the vasomotor disturbance has ceased. In blast injury, both traumatic shock and neurovegetative disturbances are present and it is in this situation that hibernation finds its best indication.

The advantages of artificial hibernation include ease of anesthesia, avoidance of operative shock, and increased comfort of the patient. Patients must be carefully watched by experienced personnel during this form of therapy, and the demands of a military situation, therefore, make it necessary to reserve this form of treatment for only a select group of wounded in base hospitals which are properly equipped. Complications include azotemia which is usually benign, and there is usually a return to normal. The azotemia is due to an increase in the formation of urea and an elevation of the renal threshold of excretion. Thromboembolic phenomena seem a little more common in patients treated by hibernation, because of prolonged intravenous intubation, suppressed activity, hypercoagulability, and vasomotor counterreaction during rewarming of the patient. It is difficult to say whether pulmonary complications are related to hibernation.

Because of the problems of evacuation in military areas in which these studies were made, hibernation was not undertaken until the patient arrived at a base hospital. In advanced medical installations, neurovegetative depression produced with phenergan and dolosal diminishes shock, facilitates evacuation, and potentiates anesthesia.

In reviewing comparative series of seriously wounded patients treated with hibernation and by the standard anti-shock therapy, the authors conclude that hibernation is indicated in about 10 per cent of the cases of severe wounds or shock. This would include patients with burns exceeding 30 per cent, severe hyperthermia, and traumatic shock resistant to the usual methods of therapy.

Thoracic and abdominal wounds pose a difficult problem, as hibernation can mask important clinical signs, and further study will be necessary to define the indications for hibernation in these cases. In the management of craniocerebral injuries, a longer period of therapy is required, and it is suggested that dolosal not be given to semi-comatose or comatose patients. Hibernation is useful in these neurovegetative disturbances which resist classical methods of treatment such as hypertonic solutions, infusions of procaine, and cooling.

—Victor M. Bernhard, M.D.

Experiences with Flaxedil in Major Surgery (Erfahrungen mit Flaxedil in der grossen Chirurgie). GUENTER SCHERER. *Deut. med. Wschr.*, 1954, 79: 612.

AS CERTAIN dangers are involved in the use of natural curare preparations, as indicated by the increasing reports in the literature, the use of synthetic preparations has been brought up. The latter differ from the natural curare preparations in the quantity of histamine which they liberate. In addition, it is difficult to regulate the effect of the natural curare as there is only a very slight difference between the dose which merely relaxes the abdominal muscles and the dose which produces complete paralysis of respiration. Synthetic preparations are more readily controlled.

Flaxedil is a 1,2,3-tri-(β-triethylammoniumethoxy)-benzol-triiodide and belongs to the group of quaternary ammonium bases. It was first used clinically in 1948, since which time various reports regarding its pharmacologic properties and its clinical possibilities have been contributed by English and French writers. German contributions consist chiefly of experimental studies.

The mode of action of flaxedil resembles that of the curarine group. It blocks the neuromuscular transmission of stimuli by reducing the current of the terminal plate below the required electric threshold. There is no central paralyzing effect. The central impulses toward the periphery are not able to reach the end organ because the terminal plate is blocked off. The

flaxedil effect may be inhibited by prostigmin—a fact that sharply distinguishes flaxedil from the decamethonium group, which has a permanent depolarizing effect which cannot be inhibited by any antidote.

The present series of cases numbered 438, and the prenarcotic therapy in most of the cases consisted of 0.02 and 0.005 of "Mo-atropin" administered in divided doses 2 hours and 1 hour before operation. Narcosis was then begun with a barbiturate preparation injected slowly in a dose of 3 to 4 c.c. to carry the patient to the tolerant stage. Through the cannula still in situ, or by means of drop infusion into an incised vein, 20 to 40 mgm. of flaxedil were then given. The 20 mgm. initial dose is usually given to patients in poor general condition. Otherwise the initial dose is 40 mgm. The muscles of the jaw and neck become relaxed 1 or 2 minutes after the injection, so that if intubation is indicated it can be performed at this time. In 3 cases 40 mgm. did not suffice to relax the muscles adequately for intubation under normal anatomic conditions, and another 20 mgm. had to be administered. It is not considered necessary to use intubation in all cases requiring flaxedil. Nor should the patient be exposed to the psychic injury of intubation under purely local anesthesia. Anesthesia is obtained with an N_2O_3 mixture in a semi-open or an open system, with or without the addition of ether or with a protracted barbiturate narcosis.

After-doses of flaxedil are administered according to the effect produced. It is desirable, if possible, to avoid such doses during the last 20 minutes of operation. However, if indicated, flaxedil may be administered in the last minutes of operation. Extubation is performed when the patient is fully awake and wishes to get rid of the tube that feels like a foreign body.

No attempts to mix flaxedil with barbiturates were made and the "Knight mixture" is not recommended.

Flaxedil must be considered a satisfactory muscle relaxant. Very large doses may lead to respiratory paralysis, but there is no indication for such doses in abdominal surgery. The undesirable effects of flaxedil are less serious than those of curare. There are no significant changes in the blood pressure, only a transitory rise in the pulse rate, and the liberation of histamine is less than after natural curare. If it should be necessary to discontinue the effect of flaxedil, this can be quickly accomplished by the administration of prostigmin. Laryngospasm developed in only 1 case and yielded to deepening of the narcosis. R. Frey reported laryngospasm in only 0.5 per cent of a large series of cases. Bronchospasm and a fall in the blood pressure may also be caused by the liberation of histamine. Initial fluctuations in the blood pressure are not infrequent, after which a certain level is attained and maintained. The blood pressure curves run fairly even and in no case displayed a tendency to drop as might be expected following the liberation of histamine.

It has been reported that within 20 minutes after the administration of flaxedil the bleeding tendency is increased because of an increased capillary permeability following the liberation of histamine. However, the histamine liberation after the administration of flaxedil amounts to only one-fifth that produced by the administration of natural curare. An increased pulse rate may, but does not necessarily, follow the administration of flaxedil. It was noted in about 25 per cent of the cases, and has been attributed to a less marked alteration of the sympathetic nerve as compared with the vagus nerve. The pulse rate acceleration usually amounts to 20 beats per minute. No electrocardiographic changes could be demonstrated. These findings suggest caution in the use of flaxedil in patients with cardiac weakness.

The danger of re-curarization is not experienced with flaxedil. With proper dosage, no prostigmin should be required. This is important as the simultaneous administration of prostigmin and atropin is not without danger. In special cases, when indicated, prostigmin acts promptly and efficiently.

—*Edith Schanche Moore*

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

The Roentgen Findings in Strangulating Obstructions of the Small Intestine. HARRY Z. MELLINS and LEO G. RIGLER. *Am. J. Roentg.*, 1954, 71: 404.

FURTHER reduction in the mortality rate of strangulated obstruction can be accomplished only by earlier diagnosis. This is particularly important in patients in whom operation would be postponed if the strangulated character of the obstruction were not recognized.

An obstruction is considered to be of the strangulated type if, in addition to a block in the intestinal continuity, there is evidence of a compromise of the blood supply. The most common cause of strangulating obstruction is the presence of adhesive bands in two separated points, producing a double obstruction. Regardless of the cause of strangulation, there are two groups of effects. The first arises because the bowel is anoxic. The luminal obstruction is followed by increase in peristaltic activity with concomitant pain. Gas and fluid accumulate above the point of obstruction. If the lumen of the upper end of the incarcerated loop is only partially obstructed, gas will enter the loop. At the same time that the lumen is occluded the mesenteric blood vessels are compressed. The veins are narrowed first and extravasation of blood is produced by the elevated capillary pressure working against an impeded venous return. Rising venous pressure causes progressive anoxia, and first hypermotility and then spasm. This is followed, as anoxia increases, by flaccidity and dilatation.

In a review of 334 small intestine obstructions seen at the University of Minnesota Hospital, Minneapolis, 34 instances of internal strangulating obstructions were found. Twenty-six cases were available for study, of which 21 were due to peritoneal adhesions and 5 to volvulus. In 60 per cent of these cases a closed loop was demonstrable. In 3 cases there were signs only of simple obstruction and in 1 case there was not even evidence of mechanical obstruction.

The evidence of an incarcerated loop may be of two types. If the loop is only partially closed it will be gas-filled or gas-and-fluid-filled. This produces what is termed the "coffee bean" sign. This is a U-shaped or hair pin loop of small intestine, the two segments of which are separated by a relatively thick zone due to edema of the intestinal wall. If there is relatively little or no gas in the closed loop the "pseudotumor" sign will be produced—a fluid-filled loop seen as a somewhat rounded or oval-shaped soft tissue density, usually lobulated in contour. The third sign is fixation of the involved group. To demonstrate this films must be made in erect, supine, and lateral decubitus positions. The fourth sign of strangulation is loss of the pattern of the valvulae conniventes in the jejunum, due to loss of tone of the muscularis mucosae. Additional signs of collateral value are:

1. The absence of gas in the small intestine in a case suspected clinically of being small intestine obstruction.
2. The presence of unusually large amounts of fluid in the lumen of the small intestine.
3. Long fluid levels.
4. Distention of a segment far out of proportion to the remaining loops.
5. Absence of decompression of a localized loop following suction. Suction siphonage is not advisable if any likelihood of strangulating obstruction is recognized.
6. The presence of a moderate amount of gas in the colon despite the apparent evidence of small intestine obstruction.

—Lois Cowan Collins, M.D.

Radiographic Diagnosis of Tumors of the Adrenal Gland. JAMES J. JOELSON, LESTER PERSKY, and FREDERICK A. ROSE. *Radiology*, 1954, 62: 488.

TO LOCALIZE a tumor of the adrenal gland the introduction of air or some other gas into the perirenal regions to outline the structures on roentgenographic study is the most useful. Tumors of the adrenal may originate from the cortex or the medulla, may be benign or malignant, and may cause severe symptoms or physical changes by the excessive secretion of specific hormones. Many of these tumors are amenable to surgical treatment, with a high percentage of cures following removal. It is imperative, therefore, to establish an accurate diagnosis.

The roentgenographic study of a patient suspected of having an adrenal tumor includes the following procedures: a plain film of the renal and adrenal regions, either an intravenous or retrograde pyelogram, and the final and most important diagnostic measure, the roentgenographic study following the perirenal insufflation with air or oxygen. The authors describe their technique of perirenal insufflation. Recently, presacral air studies have been attempted by them with fair results. Most of the fatalities following perirenal insufflation have been caused by air emboli. A large air embolus in the cardiac chambers, or smaller scattered emboli elsewhere in the vascular system may occur. Accidents can be avoided, or reduced to a minimum, by adherence to the principles of slow injection under controlled pressures and the careful selection of cases.

Several illustrative cases are presented. The differential diagnosis of soft tissue shadows in the suprarenal area may properly include cysts or tumors of the upper pole of the kidney, splenic enlargement, calcified masses, hemorrhagic or hydatid cysts in the tail of the pancreas, calcified masses in the liver, aneurysms of the celiac axis and its branches, retroperitoneal hematomas and tumors, and fluid in the gastric fundus. Many of these may be eliminated from consideration by selected roentgenologic studies, and perirenal air insufflation should make possible the differentiation of the others. The authors believe that the perirenal insufflation of air is a valuable method for the diagnosis of adrenal tumors.

—Frank L. Hussey, M.D.

Vertical Fracture of Cervical Vertebral Bodies. SAMUEL RICHMAN and ROBERT L. FRIEDMAN. *Radiology*, 1954, 62: 536.

VERTICAL fracture of the body of a vertebra is an uncommon type of injury and so far has been reported mainly in the cervical region of the spine. This fracture splits the body into almost equal right and left halves, with or without compression or other concomitant fractures.

The authors report 17 cases of this type of fracture among 80 cases of cervical spine injury, in 48 of which there was quadriplegia occurring over a 5 year period at the McGuire Veterans Hospital, Richmond, Virginia. The demonstration of a vertical radiolucent area in the region of the body of a cervical vertebra should arouse suspicion of this type of fracture. With body section studies of the spine, it is believed that the diagnosis of vertical fracture may be made with certainty.

Of the 17 fractures, 7 were caused by automobile accidents, 7 by diving into shallow water, and 3 by falls on the head. In only 1 case was there a vertical fracture only; in 6 cases there were vertical fractures with compression fractures and in 10 cases there were vertical fractures with compression fracture, dislocation, and fracture of the laminae in various combinations. C-5 was involved in 7 cases, C-6 was involved in 6 cases, and C-5 and C-6 were involved in 4 cases. Body section roentgenography was done only in 10 cases. Of the group 15 patients survived. In 4 laminectomy was performed; the remainder were treated by traction for varying periods of time. Two patients died soon after injury and postmortem examinations were obtained.

Demonstration of a vertical fracture of the body of a cervical vertebra presents conclusive evidence of severe trauma to this portion of the spine. A vertical radiolucent shadow in the region of the central portion of the body of the vertebra is more likely to be a fracture of the body, whereas, a radiolucent area situated more laterally is probably a fracture of a lamina. —*Frank L. Hussey, M.D.*

Observations on Rotational Therapy with Two Million Volt Roentgen Rays. HUGH F. HARE, MAGNUS I. SMEDAL, DAVID JOHNSTON, MAURICE COTE, and Others. *J. Am. M. Ass.*, 1954, 154: 890.

IN A 3.5 year period, about 500 patients were treated with two million volt x-rays by rotational and multiportal methods. The radiation was supplied by two electrostatic accelerators of the Van de Graaff type at the Massachusetts Institute of Technology. The radiation quality of this source was equivalent to that of the gamma rays of radium and cobalt 60. This source has two distinct advantages: (1) a high x-ray output in the beam greater than that of 6,000 gm. of radium or 4,000 curies of cobalt 60, and (2) an almost "point source" of radiation, permitting sharp beam definition with avoidance of the large penumbra that characterizes radioactive sources of even moderate output.

Because of greater penetration, freedom from scatter, and high skin tolerance, the patients tolerated more adequate treatment with less radiation sickness and less skin reaction than would be obtained with conventional deep x-ray therapy.

Rotational therapy has its greatest advantage in the treatment of smaller, more localized tumors, such as those of the pituitary, esophagus, thyroid, breast, bladder, cervix, and extremities. For larger areas, particularly when treatment to lymphatic drainage areas is indicated, multiple or opposing ports are preferable to rotation. These are usually the lymphoid tumors, and lung and abdominal tumors. Shapes and locations of portals, and dosage schedules are given for various types of tumors.

The numbers of patients treated with two-million volt roentgen rays are listed according to the type of tumor, with tabulation of the results within a 3.5 year period. —*Lois Cowan Collins, M.D.*

MISCELLANEOUS

Mortality in Swine Exposed to Gamma Radiation from an Atomic Bomb Source. JOHN L. TULLIS, BALDWIN G. LAMSON, and SIDNEY C. MADDEN. *Radiology*, 1954, 62: 409.

IN AN attempt to determine the lethal dose curve for swine after a single acute total body exposure to ionizing radiation from an atomic bomb, 90 swine were distributed in nine test stations and exposed to gamma radiation from an atomic bomb source. It is assumed that swine have about the same degree of resistance to total body radiation as human beings.

A curve obtained from the data thus accumulated shows an LD 100 dose of 390 roentgens, an LD 50 dose of 230 roentgens, and a 100 per cent survival dose of 130 roentgens. These figures are slightly lower than those obtained by previous laboratory experiments using x-ray sources of 1,000 and 2,000 kv.p. The more uniform depth dose throughout the animals subjected to the higher energy radiation may possibly account for this.

These observations cannot be reliably compared to those recorded for the human casualties at Nagasaki and Hiroshima because of numerous factors, including psychological effects, shielding by clothing and physical structures, diverse types of injury, and differences in postexposure medical treatment.

—*Lois Cowan Collins, M.D.*

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Treatment of Keloids with Hyaluronidase. THEODORE CORNBLEET. *J. Am. M. Ass.*, 1954, 154: 1161.

KELOIDS have long posed a difficult problem for surgeons, radiologists, and others interested in this complication of the healing of skin wounds. Since it has been recognized that keloids represent an abnormal growth of connective tissue, investigators have sought a key to the problem of terminating the growth phase at a normal end point in skin known to have produced keloids. The use of hyaluronidase in the treatment of keloids was suggested to the author by the work of Duran-Reynals, Bunting, and van Wagenen. These investigators injected hyaluronidase in the sex skin of macaque monkeys, in which a mucinlike material accumulated and infiltrated the collagen fibers to give rubbery resistant folds. This treatment caused collapse of these folds in 15 minutes, and the swellings did not appear to regenerate.

The author's treatment consists of the injection of 150 units of hyaluronidase, and 1 c.c. of 2 per cent procaine solution mixed with it, into the entire substance of the keloid. In cases of older lesions, this may be difficult at first. The injection is facilitated by the use of tuberculin syringes with a lock type adapter for the needle. The treatment may be given at weekly or twice-weekly intervals until the lesion softens. At this point there is gross shrinkage of the keloid with redundance of the epidermis. Usually, 8 to 12 injections suffice to prepare the lesion for surgical excision. As soon as healing of the new wound is well under way radiotherapy is employed, usually 8 to 12 treatments, giving 90 roentgens or an equivalent amount of radium at each treatment.

The author's series of cases consists of 26 patients, in 22 of whom the hyaluronidase injections were coupled with radiotherapy and surgical removal; in the other 4 cases there was no surgery. None of the keloids recurred. Sections of treated and untreated keloids were taken for microscopic study. On the basis of his findings, the author believes that the enzyme may act by causing the breakdown and subsequent removal of ground substance constituents of the keloid, and at least temporarily stimulating the secretory cycle of the fibroblasts. It may produce an exhaustion or a nonfibrogenic phase in the activity of these cells until the healing process in the wound has been completed.

—*Benjamin F. Lounsbury, M.D.*

Metastasising Nonchromaffin Paraganglioma of Thigh. K. J. RANDALL and J. B. WALTER. *J. Path. Bact.*, Lond., 1954, 67: 69.

NONCHROMAFFIN paraganglioma is an uncommon tumor occurring in such paraganglia as the carotid body, glomus jugulare, and the aortic bodies. A few reports of this tumor existing elsewhere in the body, particularly the thigh, suggest that some histologically similar tissue might be present in other regions.

This is a report on a 22 year old female who had had a soft mass deep in the soft tissues of the lateral part of the right thigh for 7 years. During a 6 month period it grew rapidly to a size of 8 by 4 inches, and partial excision was done. The remnant did not respond to irradiation so a complete excision was done, even though a probably metastatic lesion was seen in a roentgenogram of the lung. Three months later, the lung lesion was removed by right middle and lower lobectomy. In a 10 month follow-up period the patient remained in apparent good health but there were opacities in the left lung, probably metastatic, which were gradually increasing in size. There was no local recurrence in the thigh.

The primary and metastatic lesions both showed abundant, large, polyhedral cells with coarsely granular cytoplasm, arranged in groups separated by connective tissue. The large, vesicular nuclei were usually eccentric. Mitosis was infrequent. Occasional degeneration was seen at the center of some cell groups. At the periphery of the lesion, the tumor invaded the veins.

No other primary source of tumor was identified in this patient. The tumor was considered to be a malignant nonchromaffin paraganglioma arising from a chemoreceptor in the thigh.—*Stanley W. Tuell, M.D.*

Repigmentation of Amelanotic Metastases of Malignant Melanoma by Contact with Epidermis. MARTIN C. BOTHA and BERNARD LENNOX. *J. Path. Bact.*, Lond., 1954, 67: 99.

A 27 YEAR OLD white male complained of malaise and a lump in the left groin. The lump was excised and was found to be a lymph node replaced by metastatic amelanotic melanoma. Further history revealed he had had a small mole excised from his left thigh 2 years before. Subsequent review of these sections revealed a typical malignant melanoma. Despite a palpable spleen and palpable axillary nodes, left inguinal block dissection was done. Widespread metastases developed rapidly, including recurrence in the skin around the inguinal wound, and death occurred 2 months postoperatively.

At autopsy amelanotic metastases were found in the liver, spleen, multiple lymph nodes, bone marrow, meninges, lungs, myocardium, posterior pituitary lobe, and in the blood. Although no melanin was found in any of the tumor cells in these sites, there was abundant melanin production in every one of the tumor nodules in contact with the epidermis around the inguinal operative scar.

This case was believed to represent the following course of events.

A malignant melanoma produced nonpigmented metastases. When these amelanotic tumor cells were seeded into contact with the epidermis during surgery, this epidermal contact restored the ability of the cells to produce melanin. A parallel to this process is found in a hypothesis of the migration of melanoblasts in the fetus. The cells arise from the neural

crest and remain nonpigmented until they terminate their migration by invading the epidermis, where they begin to form melanin.

It is postulated that there is some factor in the epidermis necessary for the production of melanin by normal melanoblasts. —*Stanley W. Tuell, M.D.*

GENERAL BACTERIAL, PROTOZOAN, AND PARASITIC INFECTIONS

Muscular Relaxation in Tetanus with Special Reference to the Effect of Mephenesin. R. S. Dias-Rivera, Francisco Trilla, Rio Piedras, and Eduardo R. Pons, Jr. *Ann. Int. M.*, 1954, 40: 563.

The data collected in the clinical study of 15 patients with severe and moderately severe tetanus who were managed mainly as respiratory problems and received mephenesin as a muscular relaxant are analyzed.

The disease was classified as generalized tetanus in 12 patients and as cephalic tetanus in 3. Thirteen patients had generalized convulsions, either on admission or afterward. Treatment was started within 12 hours to 8 days after the onset of trismus.

Although some variation in tolerance was observed, the intravenous administration of 50 c.c. of a 2 per cent solution of the drug secured muscular relaxation in 13 of the 15 cases. Two cases required additional and repeated rectal doses of tribromethanol for efficient relaxation and the control of convulsions. In 4 patients the drug was used in doses of 100 to 300 c.c. of the 2 per cent solution diluted in 500 c.c. of 5 per cent dextrose and infused at the rate of 60 drops per minute with resultant prolonged muscular relaxation. The drug appeared to be of great usefulness and was probably life-saving in the treatment of laryngeal spasm in 6 of the cases. When used as a muscular relaxant during tracheotomy done under local anesthesia in 7 instances it appeared of little benefit in 2 of the cases. Mephenesin (6 gm. daily) given orally was not effective as a relaxant in 2 cases. Three patients developed thrombophlebitis of the arms and one of the leg veins following the use of the drug, and in 1 case anesthesia of the pharyngeal and buccal mucosa occurred when the drug was given per os.

There were 2 deaths (13.3 per cent), one attributable to heart disease and the other directly to tetanus (6.6 per cent).

Although the number of cases studied was too small to warrant definite conclusions, it appears that mephenesin has a place in the management of certain cases of tetanus until a better and less toxic muscular relaxant is available. It must be emphasized that tetanus should be managed by a team of specialists, and not by the internist alone. With full co-operation from the general surgeon, the anesthetist, and the otolaryngologist, the internist can now offer the patient with tetanus a better chance of survival.

—*Edmund A. Gorvett, M.D.*

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